

PALÆONTOGRAPHICAL SOCIETY.

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THE CRAG MOLLUSCA.

VOL. II.

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OF THE

WEALDEN FORMATIONS.

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THE EOCENE MOLLUSCA.

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1856.

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A MONOGRAPH
OF
THE CRAG MOLLUSCA,

WITH
DESCRIPTIONS OF SHELLS

FROM THE
UPPER TERTIARIES OF THE BRITISH ISLES.

BY
SEARLES V. WOOD, F.G.S.

VOL. I.
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1848.

A MONOGRAPH

THE CRAG MOLLUSCA

DESCRIPTIONS OF SPECIES

FROM THE COLLECTION OF THE BRITISH MUSEUM

BY CHARLES F. WOOD-JONES

VOL. I

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GASTRANA,* *Schum.* 1817.TELLINA (sp.) *Linn. Chemn.*VENUS (sp.) *Retz.* 1788.PSAMMOBIA (sp.) *Lam.* 1818. *Turt.* 1822. *Flem.* 1828.PETRICOLA (sp.) *J. Sow. Lam.*DIODONTA. *Desh.* 1845. *Forb. and Hanl.* 1848. *Gray,* 1851. *Woodward,* 1854.

Generic Character. Shell equivalved, inequilateral, transverse, ovate or subtrigonal, covered with concentric striæ or lamellæ. Hinge with two teeth in one valve, and one large subbifid tooth in the other. Impressions by the adductors ovate, nearly equal, that by the mantle with a sinus wide and deep. Ligament external.

Animal with the mantle open, and fimbriated margins; siphons long, unequal, and separated to their bases, with slightly fringed orifices; foot linguiform.

This appears to be a very well marked genus, and strongly characterised by its dentition. A few species only are as yet known either in a recent or fossil state. I have not seen it from any older formation than the Faluns of Touraine. One fossil species has been brought from South Africa, belonging to a tertiary deposit.

1. GASTRANA LAMINOSA, *J. Sowerby.* Tab. XXV, fig. 1, *a—e.*PETRICOLA LAMINOSA. *J. Sow. Min. Conch., t. 573, 1827.*— — *Nyst. Coq. Foss. de Belg., p. 99, pl. 3, fig. 16, 1844.*

Spec. Char. *Testá subirregulari, ovatá vel trigonulá, convexiusculá, clausá, inæquilaterali; anticè rotundatá, posticè angulatá; lamellatá, lamellis erectis acutis, striis interstitiis exilioribus; cardine bidentato; sinu palliari magno.*

Shell somewhat irregular, slightly convex, ovate or trigonular, closed, inequilateral; anterior side rounded, posterior angulated; covered with sharp and erect concentric ridges or lamellæ, and very fine radiating striæ between them; hinge with two teeth, palleal sinus large.

Length, $2\frac{1}{4}$ inches. *Height,* $1\frac{5}{8}$ inch.

Locality. Cor. Crag, Ramsholt, Gedgrave, Sutton.

Red Crag, Sutton, Alderton, Bawdsey, Walton Naze.

This species is not particularly rare either in the Coralline or in the Red Crag. It has considerable resemblance to *Tellina fragilis*, Linn. (*Petricola ochroleuca*, Lam.), but appears to differ sufficiently to be removed from that species. Like it, however, it was subject to much distortion; and though the valves are found free, its habits were probably such as to lead it into confined situations, so as oftentimes to impede the

* Etym.? γαστήρ, ventral.

regularity of growth. The principal difference between this and *G. fragilis* is a larger posterior side, which is biangulated, the posterior dorsal portion not sloping off to a point as in the recent shell: the laminæ in our fossil are also larger, more remote, and the pallial sinus extends only to a line drawn perpendicularly from the umbo; in *G. fragilis* it projects beyond. The right valve of our shell has two large diverging teeth, while the left one possesses one large central, triangular, bifid tooth, with a cavity on each side, and two small rudimentary teeth; a large fulcrum for the ligament; the laminæ are prominent, and erect, not reflexed.

Tellina fragilis, Linn., is found fossil in the Sicilian Beds, as, also, quoted in the Faluns of Touraine; but I have not seen it from the Crag.

DONAX,* *Linnaeus*. 1758.

TELLINA. *Adans*, 1757.

CHION. *Scopoli*, 1777.

CUNEUS. *Da Costa*, 1778.

SERRULA. *Chemn.* 1782.

CAPISTERIA. *Gevers*, 1787. *Sec. Gray*.

PERONÆA, PERONÆODERMA (sp.) *Poli*, 1791.

LATONA.—*Schum.* 1817.

HECUBA. *Id.*

IPHIGENIA? *Id.*

CAPSA. *Lam.* 1818.

DONACINA. *Ferus.* 1821.

EGERIA? (sp.) *Lea.* 1833.

Generic Character. Shell transverse, inequilateral, equivalved, more or less wedge-shaped; posterior side the shorter; surface generally smooth and glossy, sometimes finely striated or decussated; covered by an epidermis in the recent state. Margin plain or crenulated. Hinge composed of two cardinal teeth in one valve, and one in the other, with more or less developed lateral teeth. Muscular impressions ovate with a large and deeply indented mantle-mark. Ligament external.

Animal somewhat oblong, the mantle open in front, with fringed or partially fringed margins. Siphons not very long, separated their entire length; foot large, sharp edged, and pointed.

The principal distinction between this genus and that of *Tellina* is the truncation of the posterior side, and the general wedge-shaped form of the shell, as also the absence of the flexous fold in the margin, and it is in general more inequilateral, but the two genera are very closely allied. *Tellina* is made the type of a family by the malacologists, and the present genus is alike honoured with a similar distinction, upon what grounds they are so widely separated I am unable to discover.

A fossil from the Carboniferous Period is described under this name, but its true generic position is doubtful, and there is no certainty of its existence in the fossil state anterior to the older Tertiaries.

* Etym. *δοξα*, a sea-fish. *Pliny*.

The habits of the living species are generally littoral; and they bury themselves in the sand, leaving their siphons on a level with the surface.

1. *DONAX VITTATUS*, *Da Costa*. Tab. XXII, fig. 7, *a, b*.

| | | |
|------------------|------------------------|--|
| DONAX TRUNCULUS. | <i>Linn.</i> | Syst. Nat., ed. 12, p. 1127, fide <i>Forb.</i> and <i>Hanl.</i> |
| — — | <i>Penn.</i> | Brit. Zool., ed. 4, vol. iv, p. 93, pl. 55, fig. 45. |
| — — | <i>Lovén.</i> | Ind. Moll. Scand., p. 42, 1846. |
| — VITTATUS. | <i>Gray.</i> | List Brit. Moll., p. 46, 1851. |
| — ANATINUS. | <i>Forb. and Hanl.</i> | Hist. Brit. Moll., vol. i, p. 332, pl. 21, figs. 4—6, and pl. κ, fig. 7, 1848. |
| — RUBER. | <i>Turt.</i> | Brit. Biv., p. 127, pl. 10, fig. 14, 1822. |
| CUNEUS VITTATUS. | <i>Da Costa.</i> | Brit. Conch., p. 207, t. 14, fig. 3, 1778. |

Spec. Char. *Testá transversá, oblongá vel cuneiformi, inæquilaterali; posticè brevior, truncatá, anticè rotundatá; tenuissimè striatá, obsoletè decussatá; margine ventrali convexiusculo, crenulato.*

Shell transversely oblong or wedge-shaped, inequilateral; posterior side the shorter, truncated, and obtusely pointed; anterior rounded; striated externally and somewhat obscurely decussated; ventral margin slightly convex and crenulated.

Length, $1\frac{1}{4}$ inch. *Height*, $\frac{5}{8}$ ths of an inch.

Locality. Mam. Crag, Bramerton.

Recent, British Seas.

This common living species I have seen only from the above locality, where I am informed it is by no means rare.

2. *DONAX TRUNCULUS*, *Linnæus*. Tab. XXII, fig. 8, *a, b*.

| | | |
|-------------------|-----------------|---|
| DONAX TRUNCULUS. | <i>Linn.</i> | Syst. Nat., ed. 12, p. 1127, 1767. |
| — — | <i>Born.</i> | Test. Mus. Cæs., p. 54, t. 4, figs. 3, 4, 1780. |
| — — | <i>Poli.</i> | Test. Sicil., vol. ii, p. 76, t. 19, figs. 12—20, 1795. |
| — — | <i>Savigny.</i> | Deser. de l'Egypt, tom. xxii, p. 198, pl. 8, fig. 14. |
| — — | <i>Phil.</i> | En. Moll. Sic., vol. i, p. 36; vol. ii, p. 28. |
| — — | <i>Broc.</i> | Conch. Foss. Subappen., p. 535, 1814. |
| — — | <i>Desh.</i> | Exped. Scient. Alger. Moll., pl. 74, figs. 1—5; and pl. 75. |
| — TRUNCATA. | <i>S. Wood.</i> | Catalogue, 1840. |
| CAPSA TRUNCULUS. | <i>Hanley.</i> | Recent Shells, p. 87, pl. 11, fig. 38. |
| SERRULA LEVIGATA. | <i>Chemn.</i> | Conch. Cab., vol. vi, p. 259, pl. 26, figs. 253, 254, 1782. |
| LE GAFET? | <i>Adans.</i> | Nat. Hist. Senegal, t. 18, fig. 2. |

Spec. Char. *Testá transversá, cuneatá, lævigatá, valdè inæquilaterali; latere postico brevissimo, truncato; margine ventrali crenulato.*

Shell transverse, wedge-shaped, and smooth, inequilateral; posterior side very short and truncated; ventral margin nearly straight and crenulated.

Length, 1 inch. *Height*, $\frac{1}{2}$ an inch.

Locality. Red Crag, Sutton.

Recent, Mediterranean.

This shell is rare in my cabinet, and I have met with it from one locality only. It appears to differ from the preceding, and to correspond with the Mediterranean form in having a much shorter posterior side, it is also smoother externally, with less distinct radiating striæ, and the ventral margin not so much curved; the dentition is much the same in both species, though somewhat more strongly marked in *D. anatinus*.* The sinus in the mantle mark extends nearly to the middle, rather further beyond the hinge than in the British shell, with a few other minor differences; and as the British Conchologists have separated the recent shells into two species, the fossil forms seem to warrant a similar proceeding. Philippi mentions this among the Red Sea Shells collected by Von Hemprich and Ehrenberg.

3. DONAX POLITUS, *Poli*. Tab. XXII, fig. 9, *a*, *b*.

TELLINA POLITA. *Poli*. Test. Sicil., vol. i, p. 44, pl. 21, fig. 14, 1791.

— VINACEA. *Gmel*. Syst. Nat., p. 3238.

DONAX COMPLANATA. *Mont*. Test. Brit., p. 106, pl. 5, fig. 4, 1803.

— — *Phil*. En. Moll. Sic., vol. ii, p. 28, 1844.

— LONGA. "*Bronn*." *Phil*. En. Moll. Sic., vol. i, p. 37, pl. 3, fig. 13, 1836.

— GLABRA. *S. Wood*. Catalogue, 1840.

— POLITUS. *Forb. and Hanl*. Hist. Brit. Moll., vol. i, p. 336, pl. 21, fig. 7, 1848.

CAPSA COMPLANATA. *G. B. Sow*. Gen. of Shells, No. 10, fig. 2.

PSAMMOBIA POLITA. *Costa*. Catal. Test. Sicil., p. 20, No. 14.

Spec. Char. Testá elongato-cuneiformi, complanată, lævigată, polită, tenui, inæquilaterali; latere antico longiore; latere postico angulato; margine integro.

Shell elongately wedge-shaped, flattened or compressed, smooth and glossy, thin, inequilateral; anterior side the longer, produced; posterior angulated; margin smooth.

Length, 1 inch. *Height*, $\frac{1}{2}$ an inch.

Locality. Cor. Crag, Sutton and Gedgrave.

Recent, Britain and Mediterranean.

Small specimens not exceeding half an inch in length are abundant at Sutton, but fragments indicate a magnitude of at least an inch and a quarter. This elegant shell is beautifully glossy in those specimens that are well preserved, but the generality are

* In the 'Hist. Brit. Moll.,' vol. i, p. 340, the hinge of *D. trunculus* is said to be destitute of lateral teeth, while they are described (p. 332) as being present in *D. anatinus*. I have not been able to make that distinction. There is a prominent lateral tooth in my fossil on the posterior side, beyond the ligamental support.

more or less uncoated. Unlike the preceding species, this is free from radiating striæ, and the margin is in consequence quite smooth. The form of this is also different, and may be readily distinguished. The pallial sinus is large and deep, extending beyond the hinge area, and in some old shells the interior is considerably thickened.

Poli has given a good representation of the shell of this species; but in depicting the animal he has made the siphons to protrude on the longer, and the foot at the shorter or posterior side.

PSAMMOBIA,* *Lam.* 1818.

LUX. *Chemn.* 1782.

GARI. *Schum.* 1817.

PSAMMOTÆA. *Lamk.* 1818.

PSAMMOTEA. *Schweig.*

PERONÆA et PERONÆODERMA (sp.) *Poli.*

AZOR. *Leach*, MS., 1819. } *Sec. Gray.*

GOBRÆUS. *Id.*

PSAMMOCOLA. *Blainv.* 1824.

Generic Character. Shell equivalve, subequilateral, transversely oblong, more or less compressed, slightly gaping at each extremity; exterior generally covered with transverse or concentric striæ, and occasionally ornamented with radiating lines or ridges. Hinge composed of two teeth in one valve, and one in the other, and without lateral teeth. Sinus in the impression of the mantle large and deep. Ligament external, fulcrum prominent.

The animal has the mantle open the entire length, and bordered by a fringe of fine simple filaments; siphons long and slender, marked with longitudinal lines, and ornamented with minute cirri; a large and tongue-shaped foot, somewhat pointed.

There is no very essential distinction between this genus and *Tellina*, the greatest difference appearing to be a somewhat more oblong form of outline, and a less distinct inflexion on the posterior side of the shell, with a rather more prominent fulcrum for the ligament in *Psammobia*. In the recent state the species are, like the Tellens, inhabitants of various climes, and generally live buried in sand or gravelly mud, and they have a vertical range from low-water mark to 100 fathoms.

The name of this genus, being in fact only third in point of date, will have to be changed.

1. PSAMMOBIA FERRÖENSIS, *Chemn.* Tab. XXII. fig. 3, *a, b.*

Petiver. *Gazophyl.*, t. 94, fig. 9, 1764.

TELLINA FERRÖENSIS. *Chemn.* *Conch. Cab.*, vi, p. 99, t. 10, fig. 91, 1782.

— FERRÖENSIS. *Broc.* *Conch. Subap.*, p. 512, No. 6, 1814.

* Etym. ψαμμος, sand, and βίωω, to live.

- TELLINA FERVENNIS. *Gmel.* Syst. Nat., p. 3235, 1788.
 — — *W. Wood.* Linn. Trans., vol. vi, p. 174, t. 15, figs. 20, 21, 1802.
 — RADIATA. *Da Costa.* Brit. Conch., p. 209, t. 14, fig. 1, 1778.
 — INCARNATA. *Penn.* Brit. Zool., vol. iv, p. 74, pl. 47, fig. 31, 1776.
 — MURICATA. *Broc.* Conch. Subap., p. 511, t. 12, fig. 2.
 — TRUNCATA. *Spengler.* Fide *Lovén.*
 — TRIFASCIATA. *Don.* Brit. Shells, vol. ii, pl. 60, 1800.
 PSAMMOBIA FERRÖENSIS. *Lamk.* Hist. Nat. des An. s. Vert., v, p. 512.
 — — *Phil.* En. Moll. Sic., vol. i, p. 23, pl. 3, fig. 7, 1836.
 — — *Lovén.* Ind. Moll. Scand., p. 42, 1846.
 — — *Sismonda.* Syn. An. Invert. Pedm. Foss., p. 21, 1847.
 — DUMONTII. *Nyst.* Coq. Foss. de Belg., p. 103, pl. 4, fig. 12, 1844.
 — LÆVIS. *Id.* Coq. Foss. de Belg., p. 104, pl. 4, fig. 13.
 — MURICATA. *Id.* Coq. Foss. de Belg., p. 105.
 — — ? *Grateloup.* Cat. Zool. des An. Vert. et Invert., p. 67, 1838.
 — AFFINIS? *Dugard.* Mem. de la Soc. Geol. de France, tom. ii, part 2, p. 257, pl. 18, fig. 4, 1837.

Spec. Char. Testá transversá, ovato-oblongá, subæquilaterali, tenui; concentricè striatá; anticè rotundatá; posticè truncatá, angulatá, striatá et decussatá; margine ventrali convexiusculo; sinu palliari magno.

Shell transverse, ovately oblong, nearly equilateral, thin; concentrically striated; anterior side rounded; posterior truncated, and decussated upon the posterior slope; ventral margin slightly curved; pallear sinus large.

Length, $1\frac{7}{8}$ inch. *Height*, $\frac{7}{8}$ ths of an inch.

Locality. Cor. Crag, Gedgrave, Sutton, and Ramsholt.

Recent, Britain, Mediterranean, Finmark.

This elegant shell, in its full-grown state, is rare; but small specimens and fragments are by no means scarce. I have assigned it, without a doubt, to the existing species, although some of my fossils appear rather more transverse, or have a somewhat greater length comparatively than the recent shell. My Crag specimens are particularly thin and fragile, with scarcely a trace of any muscular impression. In some of the young specimens the radiating striæ upon the angular slope of the posterior side are strongly marked with decussating lines.

This is said to have been found fossil in the Drift beds of Lancashire and Ireland.

2. PSAMMOBIA VESPERTINA, *Chemnitz.* Tab. XXII, fig. 2, *a—d.*

- LUX VESPERTINA. *Chemn.* Conch. Cab., vol. vi, p. 72, t. 7, figs. 59, 60, 1782.
 SOLEN VESPERTINUS. *Gmel.* Syst. Nat., p. 3228, 1788.
 TELLINA VARIABILIS. *Don.* Brit. Shells, vol. ii, t. 41, fig. 2, 1800.
 — GARI. *Poli.* Test. Sicil., pl. 15, figs. 19, 21, 23, vol. i, p. 41, 1791.
 — — *Born.* Test. Mus. Cæs. Vind., p. 31, t. 2, figs. 6, 7, 1780.
 — ALBIDA. *Dilh.* Desc. Cat. Brit. Shells, vol. 1, p. 78, 1817.

- TELLINA DEPRESSA. *Penn.* Brit. Zool., ed. 4, vol. iv, p. 87, pl. 47, fig. 27.
 PSAMMOBIA VESPERTINA. *Lam.* An. s. Vert., t. 5, p. 511, 1818.
 — — *Phil.* En. Moll. Sic., vol. i, p. 22; vol. ii, p. 21.
 — — *Lovén.* Ind. Moll. Scand., p. 42, 1846.
 — — *Sism.* Syn. An. Inv. Pedm. Foss., p. 21, 1847.
 PSAMMOCOLA VESPERTINA. *Blainv.* Malac., p. 77, fig. 4, 1825.
 SANGUINOLARIA — *Flem.* Brit. Anim., p. 460, 1828.
 CHAMA LUTESCENS. *List.* Hist. Conch., t. 417, fig. 261.
 AZOR VARIABILIS. “*Leach.*” Ann. Mag. Nat. Hist., vol. xx, p. 272.

Spec. Char. Testá oblongo-ovatá, subinæquilaterali, concentricè striatá, striis obtusis depressis; anticè rotundatá, posticè subtruncatá; margine subtilissimè crenulato.

Shell ovately oblong, slightly inequilateral, concentrically striated, striæ obtuse, depressed; anterior side rounded, posterior somewhat truncated; margin very finely crenulated.

Length, 2 inches. *Height*, 1 inch.

Locality. Cor. Crag, Ramsholt and Sudbourn.

Recent, Mediterranean, British, and Norwegian Seas.

A very few specimens only of this elegant species have fallen under my observation. I have no hesitation in assigning the smaller shell (fig. 2, *c, d*), found at Rams-holt, as an identity with the recent British species. Fig. 2, *a, b*, is the representation of a specimen found by myself at Sudbourne, and the only difference appears to be in its having somewhat larger proportions, this one measuring as much as $2\frac{5}{8}$ inches in length, and $1\frac{1}{2}$ inch high; and our fossil is in all probability only a monstrous form of the existing shell. It strongly resembles *Psam. Stangeri*, Gray, ‘Faun. of New Zealand,’ p. 273, No. 179.

3. PSAMMOBIA TELLINELLA, *Lamarck.* Tab. XXII, fig. 4, *a, b*.

- PSAMMOBIA TELLINELLA. *Lamk.* Hist. des. An. s. Vert., v, p. 515, 1818.
 — — *Forb. and Hanl.* Hist. of Brit. Moll., vol. i, p. 277, pl. 19, fig. 4,
 and Animal, pl. κ, fig. 1, 1848.
 — — *Lovén.* Ind. Moll. Scand., p. 42, No. 303, 1846.
 — — *Alder.* Cat. Moll. North. and Durh., p. 89, 1848.
 — FLORIDA. *Turt.* Brit. Biv., p. 86, pl. 6, fig. 9, 1822.

Spec. Char. Testá transversá, ovato-oblongá, tenui; transversim striatá; anticè ovato-rotundatá; posticè subangulatá; margine ventrali leviter arcuato; cardine bidentato, altera unidentato, sinu palliari profundo.

Shell transverse, ovately oblong, thin, very finely striated transversely; anterior side slightly rounded, posterior somewhat angulated; ventral margin slightly curved: hinge with one tooth in one valve, inserted between two in the other; pallear sinus deep.

Length, 1 inch.

Locality. Cor. Crag, Sutton. Recent, Channel Islands, Hebrides, and Bergen.

This delicate and elegant shell is rare in my cabinet; about half a dozen small specimens and a few fragments are all that I have seen. It much resembles the young of *Ps. vespertina*, but is rather more rounded on the posterior side, and it is a deeper or more tumid shell. The hinge teeth are small, though apparently a trifle larger than those of the recent shell. The palléal sinus is large and deep, extending inwards to a little beyond the hinge denticles. It is said to extend in the living state from the Channel Islands to the coast of Bergen, and ranges vertically from five to fifty fathoms.

TELLINA,* *Linnæus*, 1767.

PETASUNCULUS. *Rumph.* 1705. *Petiver*, 1713.
 CHAMELEA (sp.) *Klein.* 1753.
 PERONÆA ET PERONEODERMA (sp.) *Poli.* 1791.
 TELLINARIUS (sp.) *Dum.* 1806.
 ANGULUS. *Megerle*, 1811.
 OMALA. *Schum.* 1817.

ARCOPAGIA. *Leach* MS. 1816. *Brown*, 1827.
 PHYLLODA. *Schum.* 1817.
 TELLINIDES. *Lamk.* 1818.
 MACOMA. *Leach*, 1819.
 LIMICOLA. *Id.* 1819. Fide *Gray*.
 HOMALA. (sp.) *Agassiz*.

Generic Character. Shell transversely ovate, or suborbicular, generally inequilateral, plain or smooth, but more frequently sculptured or ornamented; posterior side more or less angulated, with an irregular flexuosity produced by a slightly sinuated form in the posterior part of the ventral margin. Hinge with generally two cardinal and two lateral teeth in each valve, the latter, in some species, are obsolete. Palléal impression deeply sinuated. Ligament external.

Animal of the form of the shell, having the mantle open in front, with the margins fringed; siphons long, sometimes four or five times the length of the shell, separate throughout, the orifices plain or indistinctly toothed; foot large, triangular, and compressed.

The character by which this genus is said to be most distinguished is the flexuous fold, or slightly twisted form of the posterior side of the shell; this, however, is not always discernible, thereby merging into *Sanguinolaria* and *Psammobia* which are characterised by the absence of the fold, and the want of lateral teeth, though in some species of this genus the latter character is by no means permanent. The outward form of *Tellina* is exceedingly variable, some species being nearly orbicular, while others are much elongated; in general the shells are slightly compressed, somewhat unequal in size, one valve being more tumid than the other, especially on the posterior side, where the ligament is placed; and this side is generally, though not always, the shorter of the two.

* Etym. Τελλίνη, the name of a mussel.

A peculiarity exists in many of the species, as well as in some of the species of its generic allies, by which a considerable variation is produced in the degree of tumidity at the posterior part of the opposite valves, causing the impression of the mantle upon the interior to display a difference in form as well as in extent; the compressed or right valve having its sinus shorter and somewhat broader or higher, while in the more tumid one it extends forward so as almost to touch the anterior adductor. This does not appear to depend upon a difference in length of the two siphons, as in some of the members of this, so called, family, which are furnished with tubes of an unequal length, this difference in the sides of the animal does not exist, and the mantle-mark is the same in both valves; but in others, in which the tubes are precisely alike, this inequality in the valves is very conspicuous; the difference in the mantle-mark appearing to be coexistent with the difference in the tumidity of the valves.

If the drawings by malacologists be correct, the inhalent siphon is the longer one in some species, while in others, this lower or indrawing tube is the shorter of the two, and apparently without producing any difference of tumidity at the posterior part of the valves. It is, however, doubtful whether a safe reliance can be placed upon the published figures of the Bivalve Molluscs, as some of the animals are represented with the upper siphon most extended, while in other very proximate species the lower projects beyond the upper one. Mr. Alder informs me these siphons are so elastic that either may be made to appear the longer at the will of the animal, which perhaps is the cause of this apparent diversity.

The inequality of proportions in the two valves gives to them a degree of obliquity, and, when viewed in a position with the animal upon its ventral margin or standing upon its foot, indicates an inflexion or incipient spirality in a dextral direction. The want of symmetry in the two valves does not pervade the whole group; for species evidently otherwise very closely allied are not possessed of this deformity.

Amongst other peculiarities of this genus may be mentioned *T. Burneti*, rather an aberrant species, brought from the Coast of California, it has its *right* valve quite flat, while the left is convex or lenticular; and in the newer Tertiaries of South Carolina there is a fossil species strongly resembling it in general form, but which differs from it in having the *left* valve the flat one. In both of these species the sinus in the mantle-mark is large and deep, but is unlike that of our other unsymmetrical shells in being of the same form and magnitude in both valves.

Notwithstanding the great curtailment of this genus since its original establishment by Linnæus, it still contains a very large number of species, particularly in the recent state; and these have a wide geographical distribution, extending from the Equator to the Polar Regions, and they range vertically from low-water mark to nearly 100 fathoms. The genus appears as early as the Coral Rag, with some doubtful forms in the Palæozoic Formations. In the older Tertiaries, twenty-three species have been figured and described by Mr. Edwards from the deposits of that period in this country alone, and ten were inhabitants of the seas by which the Crag was deposited.

1. *TELLINA CRASSA*, *Pennant*. Tab. XXI, fig. 1, *a—e*.

- TELLINA CRASSA*. *Penn.* Brit. Zool., ed. 4, p. 73.
 — — ? *Dujard*. Mém. de la Soc. Géol. de France, t. 11, pl. 11, p. 258, 1837.
 — — *Smith*. Mem. Wern. Soc., vol. viii, p. 93.
 — — *Phil.* En. Moll. Sic., vol. ii, p. 23, 1844.
 — — *Lovén*. Ind. Moll. Scand., p. 41, No. 296, 1846.
 — — *Sismonda*. Syn. Meth. An. Inv. Ped. Foss., p. 21, 1847.
 — *RIGIDA*. *Pulteney*. In Hutchen's Hist. of Dorset, p. 30.
 — *SCABRA*. *Chemn.* Conch. Cab., vol. vi, t. 10, fig. 94.
 — *MACULATA*. *Adams*. Linn. Trans., vol. iii, p. 252.
 — — *Turt.* Brit. Biv., p. 108, pl. 6, fig. 7, 1822.
 — *OBTUSA*. *J. Sow.* Min. Conch., t. 179, fig. 4.
 — — *Nyst.* Coq. Foss. de Belg., p. 106, pl. 5, fig. 1, 1844.
 — *SUBROTUNDA*. *Phil.* En. Moll. Sic., vol. i, pp. 29 and 255, 1839.
VENUS CRASSA. *Gmel.* Syst. Nat., p. 3288.
PECTUNCULUS PLANUS CRASSUS. *List.* Hist. Conch., fig. 136, 1687.
 — *DEPRESSIOR*. *Da Costa*. Brit. Conch., p. 194, t. 13, fig. 4, right-hand figure.
ARCOFAGIA CRASSA. *Brown*. Illust. Brit. Conch., pl. 16, fig. 8, 1827.
 — *OVATA*. *Id.* Illust. Brit. Conch., pl. 16, figs. 9, 10.
Dale. Hist. and Antiq. of Harwich, t. 11, fig. 13, 1730.

Spec. Char. *Testá crassá, ovato-ellipticá, transversá, depressá, utrinque æqualiter rotundatá; latere postico brevior; lineis creberrimis, elevatis, lamelliformibus ornata.*

Shell thick, ovate or elliptical, transverse, depressed both sides, equally rounded; posterior one the shorter, ornamented with elevated close set ridges or lamellæ.

Length, 2 inches. *Height*, $1\frac{1}{2}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton, Walton Naze.

Mam. Crag, Chillesford.

Clyde Beds. (*Smith*.)

Recent, Britain, Coast of Scandinavia.

This shell is rare in the Coralline, but it becomes abundant in the Red Crag, at Sutton, though very scarce at Walton Naze. There is a slight flexuous fold on the posterior margin, produced by the small sinus in the margin; and the exterior is covered with numerous raised ridges forming obtuse lamellæ, scarcely reflexed; between these are fine, distinct, radiating or interstitial striæ; the right valve is the more tumid of the two. The pallical sinus is large and deep, with an upward direction extending more than half way across the shell; the adductor muscle marks are deeply impressed, particularly the anterior one, within which is a thickened obtuse ridge from beneath the umbo to the lower part of the adductor. Old shells are often thickened on the inside, thereby deepening the muscular impressions.

The figure of *T. subrotunda*, Des. 'Coq. Foss. des Env. de Paris,' tom. i, p. 81, pl. 12, figs. 16, 17, strongly resembles this species, and is considered as identical by Philippi;

but in the description by M. Deshayes, that author says it differs from *T. crassa*, Penn., in having only one lateral tooth, and the concentric striæ are finer; there is no mention of any interstitial striæ, nor of the thickened internal ridge on the anterior side. *T. obovata*, F. Edwards, 'Geol. Journ.,' No. 11, p. 49, pl. 2, fig. 2, resembles our shell in outline, and may probably, when more specimens have been obtained, and it becomes better known, be the same as *T. subrotunda* of Deshayes; but until a fair comparison be instituted, *T. crassa* can scarcely be considered as dating its specific existence from the Older Tertiaries.

This species has a range in depth extending from low-water mark to below 50 fathoms, and its favorite habitat is in gravelly sand. It is found fossil in the Belgian Crag, and in the newer Tertiaries of Calabria, but it is not known as a living species in the Mediterranean.

Tab. III, fig. 18, 'Phil. En. Moll. Sic.,' called *T. radula*, is probably this species.

2. TELLINA BALAUSTINA, *Linnæus*. Tab. XXI, fig. 4, *a—d*.

| | | |
|---------------------|-----------------|---|
| TELLINA BALAUSTINA. | <i>Linn.</i> | Syst. Nat., ed. 12, p. 1119, No. 61, 1767. |
| — | — | <i>Poli.</i> Test. Sicil., vol. i, p. 49, 1791. |
| — | — | <i>Phil.</i> Enum. Moll. Sic., vol. i, p. 25; vol. ii, p. 21. |
| — | — | <i>Forbes.</i> Report Ægean. Invert., p. 180, 1843. |
| — | TENUILAMELLOSA. | <i>Nyst. et West.</i> Nouv. Rech. Coq. Foss. d'Anv., p. 7, pl. 3, fig. 6, 1839. |
| — | — | <i>Nyst.</i> Coq. Foss. de Belg., p. 109, pl. 4, fig. 14 <i>a, b</i> , 1844. |
| — | OVALOIDES. | <i>S. Wood.</i> Catalogue, 1840. |
| LUCINA BALAUSTINA. | <i>Payr.</i> | Cat. Moll. Cors., p. 43, pl. 1, figs. 21, 22, 1826. |

Spec. Char. Testá transversá, ovatá, convexá, subinæquilaterali, tenui; anticè rotundatá, posticè subangulatá; lamellatá lamellis erectis tenuibus, distantibus; cardice bidentato, dentibus lateralibus magnis.

Shell transverse, ovate, convex, slightly inequilateral, thin; anteriorly rounded, posteriorly subangulated; covered with distant, thin, erect lamellæ; hinge with two cardinal teeth and large lateral teeth.

Length, $\frac{5}{8}$ ths. *Height*, $\frac{1}{2}$ an inch.

Locality. Cor. Crag, Sutton.

Recent, Ægean, Mediterranean, and British.

Very few specimens of this delicate and pretty species have fallen to my researches, and those are all from one locality. The exterior is ornamented with very fine and numerous concentric striæ, and distant, sharp, elevated ridges or lamellæ; the last are so thin that many of them are rarely left upon the surface; the posterior side is the smaller, slightly truncated, or rather biangulated, with an incipient fold very far back; the right valve has two cardinal teeth, posterior one the larger and subbifid; two lateral teeth nearly equidistant, anterior one large, the other nearly obsolete;

left valve with one cardinal subbifid tooth, and elevated dorsal margins to interlock with the lateral teeth of the opposite valve. One side of the right valve is somewhat compressed, causing thereby a difference of form in the siphonal scar.

The nearest approach to this species that I am acquainted with is *T. lamellulata*, F. Edwards, 'Lond. Geol. Journ.,' vol. i, p. 14, pl. 23, fig. 2, but that shell seems rather more equilateral, flatter, and less truncated, with more numerous elevated lamellæ. M. Edwards' specimens are not in very good preservation.

3. TELLINA OBLIQUA, J. Sowerby. Tab. XXI, fig. 7, a—d.

| | | |
|------------------|---------------------|---|
| TELLINA OBLIQUA. | J. Sow. (not Lamk.) | Min. Conch., t. 161, fig. 1, 1817. |
| — | — | Nyst. Coq. Foss. de Belg., p. 107, pl. 5, fig. 2, 1844. |
| — | — | Lyell. Elem. of Geol., 2d ed., p. 299, fig. 14, 1841. |

Spec. Char. *Testá subrotundatá, obliquá inæquilaterali, crassá, lævigatá vel irregulariter striatá; anticè rotundatá; posticè truncatá, subangulatá; cardine bidentato, dentibus lateralibus obsoletis.*

Shell rather rounded, oblique, inequilateral, thick, and strong; anterior side rounded; posterior truncated or subangulated, smooth, or covered with irregular lines of growth; hinge with two cardinal teeth, lateral teeth obsolete.

Length, $1\frac{6}{8}$ inch. *Height*, $1\frac{6}{8}$ inch.

Locality. Cor. Crag, Sudbourn, Ramsholt.

Red Crag, Sutton, Bawdsey, Felixstow, Ipswich.

Mam. Crag, Chillesford.

This shell first appears in the lower or Coralline Crag, where it is not very abundant; in the succeeding period, or Red Crag, it may be found in most localities. The species may be called obliquely circular, or rather lenticular, the height being very nearly if not quite equal to the length; the valves are somewhat tumid, and covered with irregular lines of growth, and the posterior side is rather the shorter of the two, with the fold very far back; this side is compressed in the right valve, but tumid in the left; the inequality of the two valves at that part having relation to the unequal magnitude of the siphonal scar in the different valves; the lateral teeth may be said to be wholly wanting, as in the proximate genus *Psammobia*.

4. TELLINA LATA, Gmelin. Tab. XXI, fig. 6, a—d.

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| TELLINA LATA ALBA. | List. | Hist. Conch., fig. 253, 1686. |
| — | LATA. | Gmel. 1788. (Not Quoy and Gaim.) Fide Lovén. |
| — | — | Midden. Sibiria Reise, vol. ii, part 1, pl. 23, figs. 4, 5. |
| — | — | Lovén. Ind. Moll. Scand., p. 41, 1846. |

- TELLINA OVATA. *J. Sow.* Min. Conch., t. 161, fig. 2, 1817.
 — — *Phil.* En. Moll. Sic., vol. i, p. 30 ; vol. ii, p. 23.
 — — *Nyst.* Coq. Foss. de Belg., p. 108, pl. 5, fig. 3, *a, b*, 1844.
 — OVALIS. *Woodw.* Geol. of Norf., p. 43, pl. 2, fig. 11, 1832.
 — SABULOSA. *Spengler.* Sec. *Lovén.*
 — CALCAREA. *Wahlenb.* Sec. *Lyell.* Geol. Trans., vol. vi, 2d series, p. 137, pl. 16, figs. 9—11, 1839.
 — — *Möller.* Ind. Moll. Groenl., p. 20, 1842.
 — PROXIMA. *Smith.* Mem. Wern. Soc., vol. viii, p. 105, pl. 1, fig. 21, 1838.
 — — *Sow.* Append. Beechey's Voy., p. 154, t. 44, fig. 4, 1839.
 — — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 307, pl. 21, fig. 1, 1848.
 — EDENTULA. ? *Brod. and Sow.* Zool. Journ., vol. iv, p. 363, 1829.
 — — ? *Gray.* App. Beech. Voy. Zool., p. 154, t. 41, fig. 5 ; and t. 44, fig. 7, 1839.
 — SORDIDA. *Couthony.* Bost. Journ. Nat. Hist., vol. ii, p. 59, pl. iii, fig. 11, 1839.
 — TRIANGULARIS. *Lyell.* Phil. Trans., 1835, p. 36, fide *Lovén.*
 — TENERA. *Gray.* List Brit. Moll., p. 42, 1851.
 SANGUINOLABIA SORDIDA. *Gould.* Invert. Massach., p. 67, 1841.
 MACOMA TENERA. *Leach.* Ann. of Phil., vol. xiv, p. 204, 1819.

Spec. Char. *Testá ovatá, transversá, inæquilaterali ; anticè longiore rotundatá ; posticè sub-angulatá ; dentibus utrinque binis, lateralibus nullis.*

Shell ovate, transverse, inequilateral ; anterior side the longer and rounded ; posterior obtusely angulate, with two teeth in each valve ; lateral teeth none.

Length, $1\frac{3}{4}$ inch. *Height*, $1\frac{1}{4}$ inch.

Locality. Red Crag, Sutton.

Mam. Crag, Bramerton, Chillesford.

Clyde Beds, Uddevalla, Russia, Canada.

Recent, Finmark, N. E. Coast of America, Britain,
Behring's Straits (*G. B. Sowerby*).

I have never seen the present species from the Older or Coralline, and only rarely from the Red Crag, and never at Walton-on-the-Naze. In the Mammaliferous Crag Period the two species appear to be more equally distributed, although the oblique form is there giving way to its more transverse successor, while this latter species only, remains at the present day, and seems to be restricted to the colder regions of the Northern Hemisphere. In this, as in the preceding species, there is a considerable difference in the form and depth of the siphonal scar in the two valves, and the posterior side of this one is much more pointed than that of *obliqua*, and the line of the ventral margin is not only less curved but is somewhat constricted on the posterior side. *T. lata*, Middendorff, 'Malac. Ross.,' found in the Arctic Seas and Behring's Straits, may probably be a dwarf variety of our shell, connecting it with *T. Balthica*, which it resembles in many of its characters.

5. *TELLINA BENEDENII*, *Nyst* and *Westendorp*. Tab. XXI, fig. 2, *a—d*.

TELLINA ZONARIA. *Nyst*, (not *Lamk.*) Rech. Coq. Foss. Prov. d'Anv., p. 14, 1836.

— *BENEDENII*. *Nyst* et *West.* Nouv. Rech. Coq. Foss. d'Anv., p. 7, No. 13, pl. 2, fig. 5 bis; pl. 3, fig. 5, 1839.

— — *S. Wood.* Catalogue, 1840.

Spec. Char. *Testá ovatá, subæquilaterali, æquivalvi, complanatá, lævigatá, crassá; anticè rotundatá; posticè angulatá, subacuminatá, valvá alterá dente cardinali duo; impressione palliari magno.*

Shell ovate, slightly inequilateral, equivalved, compressed, smooth, and thick; anterior side rounded; posterior angulated, and somewhat pointed, two cardinal teeth in each valve; palleal sinus large.

Length, 2 inches. *Height*, $1\frac{1}{2}$ inch.

Locality. Red Crag, Sutton.

My cabinet contains a single specimen of each valve, which are all that I have seen. This species somewhat resembles *T. prætenuis*, from which, however, it may be readily distinguished. The umbo is somewhat prominent, it has a thickened hinge furnished with two cardinal teeth in each valve, one small and simple, the other bifid; the simple one is posterior in the left valve, anterior in the right; besides which there is an obtuse lateral tooth on the anterior side of the left valve, and a corresponding depression on the anterior dorsal slope in the right, for its reception; the adductor muscles are large and deep, and the sinus in the mantle is of an elliptical form, extending about two thirds across the shell.

The valves have a small and general convexity, and there is no tumid swelling on the one side, or compression on the other, hence the similarity in the siphonal scar; the surface is smooth(?), but may have been worn so; and there are traces of the brownish coloured zones, which M. Nyst speaks of as ornamenting the Belgian fossil.

6. *TELLINA PRÆTENUIS*, *Leathes'* MSS. Tab. XXI, fig. 5, *a—c*.

TELLINA PRÆTENUIS (*Leathes'* MS.) *Woodw.* Synop. Tab. Brit. Organ. Rem., p. 11, 1830.

— — *Woodw.* Geol. of Norf., t. 2, fig. 12, 1832.

Spec. Char. *Testá ovato-trigoná, inæquilaterali, tenui, lævi; anticè majiore, rotundatá, et convexiusculá; posticè biangulatá, subrostratá, et compressá; cardine bidentato; dentibus lateralibus nullis.*

Shell ovato-trigonal, inequilateral, thin, and smooth; anterior side the larger, rounded, and somewhat convex; posterior biangulated, rather pointed, and compressed; hinge with two cardinal but no lateral teeth.

Length, $1\frac{3}{4}$ inch. *Height*, $1\frac{1}{4}$ inch.

Locality. Red Crag, Sutton, Walton Naze.

Mam. Crag, Bramerton, Postwick, and Chillesford.

This shell in some parts of the Red Crag is exceedingly abundant, though rare at Walton on the Naze. At Sutton I have frequently found specimens with the valves united and the ligament preserved, strong presumptive evidence of their having lived and died in the locality wherein they were found.

This species was named by the late Rev. G. R. Leathes, in consequence of its connexion or resemblance to *T. tenuis*, perhaps its nearest relative. It is somewhat in form like *T. Balthica*, but is not so tumid or thick: it differs from *T. tenuis* in having more height, with a greater convexity in the ventral margin; the two teeth in each valve are alternately simple and bifid, the bifid one is anterior in the left valve, and vice versa; and there are no lateral teeth, but there is a very distinct one on the anterior side in *T. tenuis*, and in that species the mantle mark is comparatively larger.

In well-preserved specimens, the surface is covered with fine concentric striæ, or lines of growth, more especially upon the posterior slope, and the right valve is the more tumid of the two; there is also a slight difference in the magnitude of the palleal sinus in the opposite valves.

The shell which really makes the nearest approach to this species is one that was brought from the S. E. Coast of Australia.

7. TELLINA BALTHICA, *Linnæus*. Tab. XXII, fig. 1, *a—c*.

- TELLINA BALTHICA. *Linn.* Syst. Nat., ed. 12, p. 1120, No. 68.
 — — *Born.* Test. Mus. Cæs. Vind., p. 38, t. 11, fig. 14, 1780.
 — — *Phil.* En. Moll. Sic., vol. i, p. 28; and vol. 2, p. 22.
 — BALTHICA. *Lyell.* Phil. Trans., 1835, p. 34, var. *a*, pl. 11, figs. 1, 2; var. *b*, figs. 3, 4.
 — SOLIDULA. *Pulteney.* In Hutchin's Hist. Dorset, p. 29.
 — — *Woodw.* Geol. of Norf., pl. 2, fig. 13, 1832.
 — — *Lovén.* Ind. Moll. Scand., p. 41, 1846.
 — — *Middend.* Mal. Ross., loc. cit., p. 577, 1849.
 — RUBRA. *Da Costa.* Brit. Conch., p. 211, t. 12, figs. 4, 4, 4.
 — CARNARIA. *Penn.* Brit. Zool., vol. iv, p. 88, pl. 49, fig. 32.
 — — *J. E. Gray.* List of Brit. Moll., p. 41, 1851.
 — ZONATA. *Gmel.* Syst. Nat., p. 3238, No. 52.
 — INCONSPICUA. ? *Brod. and Sow.* Zool. Journ., vol. iv, p. 363, 1829.
 — — ? *Gray.* Zool. Beechey's Voy., p. 153, t. 41, fig. 6, 1839.
 — GROENLANDICA. (*Beck.*) *Lyell.* Trans. Geol. Soc., vol. vi, 2d series, pl. 16, fig. 8, 1839.
 PSAMMOBIA FUSCA. *Say.* Journ. Acad. Nat. Sc., v, p. 220.
 — SOLIDULA. *Turt.* Brit. Biv., p. 95, t. 8, fig. 2, 1822.
 SANGUINOLARIA FUSCA. *Conrad.* Am. Mar. Conch., 34, pl. 7, fig. 1.
 — — *Dekay.* Nat. Hist. New York (Zoology), pl. 32, fig. 304.
 LIMICOLA CARNARIA. "*Leach.*" *Sec. Gray.*

Spec. Char. *Testá orbiculato-ovatá, tumidá solidulá ; anticè rotundatá, posticè subangulatá ; cardine bidentato, dentibus lateralibus nullis.*

Shell roundly ovate, tumid, thick, and strong ; anterior side rounded, posterior somewhat angulated ; cardinal teeth two, lateral teeth none.

Length, $\frac{6}{8}$ inch. *Height*, $\frac{5}{8}$ inch.

Locality. Mam. Crag, Bramerton, Weybourne, Bridlington, Dalmuir, Russia, Canada.

Recent, Britain, Baltic, N. E. Coast of America, Black Sea.

I have not seen this shell from the Red Crag ; as it is, however, an estuary species, it is less likely to be there. In the recent state, it is often found high up in our rivers, where the water is nearly fresh when the tide is out. The shells grow large and thick in muddy localities, and thinner and more delicate in sandy places.

Tellina, is probably its most appropriate place, although the entire absence of lateral teeth does not strictly accord with the diagnosis of this genus, but it corresponds with it in all other respects.

Fig. 1 *a, b*, is the representation of a shell from Clacton, where I obtained it from the Clay in which *Unio littoralis* is found in abundance ; and upon some of my specimens of *Unio* are several barnacles, evidently showing the close proximity of the sea to this fresh-water deposit when it was formed.*

I have myself obtained only few specimens of the fossil from Norfolk, but I am informed it is not rare.

8. TELLINA FABULA, *Gronovius*. Tab. XXI, fig. 3.

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| TELLINA FABULA. | <i>Gron.</i> | Zoophyl. Gronov., p. 263, No. 4, pl. 18, fig. 9, 1781. |
| — | — | <i>Phil.</i> Enum. Moll. Sic., vol. i, p. 26, t. 3, fig. 10, 1836. |
| — | — | <i>Lyell.</i> Mag. Nat. Hist., vol. iii, new series, p. 327, 1839. |
| — | — | <i>G. B. Sow.</i> Thesau. Conch., vol. i, p. 287, pl. 57, fig. 62. |
| — | — | <i>Forb. and Hanl.</i> Hist. Brit. Moll., vol. i, p. 302, t. 19, fig. 9. |
| — | DISCORS. | <i>Pulteney.</i> Hutchin's Dorset, p. 54. |
| — | SEMISTRIATA. | <i>Solander, ex Montague.</i> |

Spec. Char. "*Testá elongato-ovatá, compressá, transversá subinæquilaterali, tenui ; posticè attenuatá, subrostratá, anticè majiore rotundatá ; valvula sinistra levi, dextrá obliquè striatá ; cardine bidentato, dentibus lateratibus parvis.*"

Shell transversely elongato-ovate, compressed, sub-inequilateral, thin ; posterior side narrow, and somewhat pointed ; anterior broader, larger, and rounded ; left valve

* At Clacton I have also obtained *Mytilus edulis*, *Cardium edule*, and *Trigonella plana*, and also a rolled specimen of *Melania inquinata* (*Cerithium melanioides*, Sow.).

smooth; right valve covered with oblique striæ; hinge with two cardinal teeth, and small lateral tooth.

Length, $\frac{3}{4}$ inch. *Height*, $\frac{1}{4}$ inch.

Locality. Mam. Crag, Southwold.

Recent, British Seas, Mediterranean.

One specimen was found by Captain Alexander some years since, but it is now unfortunately lost. I am, however, certain of its existence as a Crag shell, and have in consequence given the representation of a recent individual.

Philippi gives it as a living species in the Mediterranean, but not as a fossil from that part of the world. He places it in his section of the genus "*dentibus lateralibus carentes*." It is not, however, strictly speaking, destitute of lateral teeth; there is a distinct and proximate one on the anterior side of the right valve, and another smaller, but more remote, on the posterior margin, immediately beyond the ligamental fulcrum. The right valve is prettily ornamented with numerous oblique striæ, placed close and straight on the siphonal side, and are rather more distant and wavy on the anterior half.

This I have found in the recent state on the sandy shores of the Eastern Coast of England, and almost within the reach of fresh water. It is usually a littoral species, and is said to range to the depth of ten or twelve fathoms.

9. TELLINA DONACINA, *Linnaeus*. Tab. XXII, fig. 5, *a*, *b*.

- TELLINA DONACINA. *Linn.* Syst. Nat., ed. 12, p. 1118, No. 59, 1767.
 — — *Phil.* En. Moll. Sic., vol. i, p. 24; vol. ii, p. 21.
 — — ? *Dujard.* Mem. Geol. Soc. Fr., tom. ii, part 2, p. 258, 1837.
 — — *Desh.* Exped. Scient. Alg. Moll., pl. 69, figs. 1—3.
 — — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 292, pl. 20, figs. 3, 4;
 and pl. κ, fig. 4, 1848.
 — — *Middend.* Malac. Rossica, p. 576, 1849.
 — TRIFASCIATA. *Penn.* Brit. Zool., ed. 4, vol. iv, p. 75, No. 33.
 — VARIEGATA. *Poli.* Test. Sicil., vol. ii, p. 45, t. 15, fig. 10.
 — SUBCARINATA. *Broc.* Conch. Foss. Subap., p. 512, t. 14, fig. 5, 1814, fide *Phil.*
 — LLANTIVYI. *Payr.* Cat. Moll. Cors., p. 40, pl. 1, figs. 13, 14, 1826.
 — LUSORIA. (*Say.*) fide *Lyell.* Proc. Geol. Soc., vol. iv, part 3, p. 555, 1845.
 DONAX STRIATELLA. *Nyst.* Coq. Foss. Belg., p. 116, pl. 4, fig. 15 *a*, *b*, 1844.

Spec. Char. Testá transversá, elongatá, vel ovato-oblongá, compressiusculá, tenuissimè striatá, inequilaterali, latere postico brevior, obtusè angulato; impressione palliari magno profundo.

Shell transverse, elongate, subtrapezoidal, somewhat compressed, inequilateral, and finely striated; posterior side the shorter, obtusely angulated; impression of the mantle large and deep.

Length, $\frac{6}{8}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

Clyde Beds. Recent, Britain, Mediterranean, and North Seas. (*Midd.*)

This species is exceedingly abundant in the Coralline Crag, but I have seen it only in one locality. The pallial impression is very large and deep, extending inwards until it almost touches a sort of ridge or thickening of the shell between it and the impression of the anterior adductor; the lateral teeth are at unequal distances: two obtuse ridges diverge from the umbo to the ventral margin on the siphonal side, most distinct in the right valve, upon the interior of full-grown specimens; in the left, these markings, instead of being in relief, are impressed. Upon some of my fossils there are the remains of continuous coloured bands, not intercepted by white radiations. None of my Crag specimens have attained to so great a magnitude as is given to the recent British shell, my largest scarcely reaching three fourths of an inch in length. This has been well named: it strongly resembles a *Donax* in all its characters.

A specimen, in the cabinet of Sir Charles Lyell, has the locality of Bramerton attached to it.

10. *TELLINA DONACILLA*, *S. Wood*. Tab. XXII, fig. 6, *a*, *b*.

TELLINA DONACILLA. *S. Wood*. Catalogue, 1840.

Spec. Char. *Testá transversá, ovato-oblongá, subinæquilaterali, compressiusculá, politá; posticè breviorè, truncatá, biangulatá; anticè rotundatá; cardine bidentato; dentibus lateralibus duobus.*

Shell transverse, ovately oblong, somewhat inequilateral, compressed, glossy; posterior side the shorter, truncated, and biangulated; anterior side rounded; two cardinal, and two lateral teeth.

Length, $\frac{11}{16}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

This shell appears to be rare, one specimen of each valve, in my own cabinet, are all that I have as yet seen. It very much resembles in outline *T. Oudardii*, Payr., 'Moll. Cors.,' p. 40, pl. 1, fig. 16—18, and I had considered it different, in consequence of the want of the peculiarly characteristic marks of that species, which has the exterior, as stated by the author, beautifully ornamented with lozenge-shaped cancellæ, formed by radiating striæ intersecting the lines of growth. If these lines be upon the recent shell and not alone in the epidermis, our fossil does not possess them. The surface is covered with some broad and flat obsolete ridges on the body of the shell, which are sharp and elevated upon the posterior slope. It is flatter than *T. donacina*, less inequilateral, and has not the fine and regular striæ of that species. It also somewhat resembles the figure of *T. compressa*, Broc., pl. 12, fig. 9; and may possibly belong to one of the Mediterranean or Subappennine species, but I have not been able to obtain specimens for comparison.

Our shell has two diverging cardinal teeth in the right valve, with one large,

elongated, lateral tooth on the anterior side, and one lateral tooth on the posterior slope, beyond the large and prominent fulcrum for the ligament; this fulcrum is so conspicuous, as almost to justify the species being placed in the genus *Psammobia*, and forms one of the links that so closely unite that genus with *Tellina*. The left valve has one large triangular cardinal tooth, and a rudimentary one behind it, with corresponding elevations or teeth, which fit into the lateral depressions of the right valve; and there is an obscure diagonal ridge on the inside, from beneath the umbo towards the anterior side of the ventral margin. The palléal scar is not well defined in our shell, but is probably very large and deep.

Tellina tenuis is enumerated in Mr. Smith's 'List of the Clyde Fossils.'

TRIGONELLA. *Da Costa*. 1778.

| | |
|---|---|
| SPOONMUSSEL. <i>Petiver</i> . | LAVIGNON. <i>Cuv.</i> 1817. |
| MACTRA (sp.) <i>Gmelin</i> . | LUTRARIA (sp.) <i>Lam.</i> 1818. <i>Swains.</i> 1840. |
| MYA (sp.) <i>Chemn.</i> | LISTERA. <i>Turt.</i> 1822. |
| TELLINA (sp.) <i>Donov.</i> | LUTRICOLA. <i>Blainv.</i> 1824. |
| LIGULA (sp.) <i>Mont.</i> 1808. | AMPHIDESMA (sp.) <i>Flem.</i> 1828. |
| SOLENI (sp.) <i>Oliv.</i> | CALCINELLA. <i>Agass.</i> 1842. |
| ARENARIA. <i>Megerle.</i> 1811. | SEMELE (sp.) <i>Woodw.</i> 1854. |
| SCROBICULARIA. <i>Schumacher.</i> 1817. | |

Generic Character. Shell equivalved, subequilateral, somewhat compressed, nearly smooth. Hinge furnished with two small cardinal teeth in the right valve, and one in the left; no lateral teeth. Muscular impression ovate. Palléal sinus large and deep. Ligament small, external. Cartilage large, internal.

Animal with its mantle open, having the margins denticulated. Siphonal tubes long, slender, and disconnected, with simple orifices. Foot large, tongue-shaped, and compressed.

This genus is closely allied to *Tellina*, differing only in the arrangement of the hinge furniture. In *Trigonella* the ligament is small and external, separated from the cartilage, which is large, and placed in an expanded, spoon-shaped process. In *Tellina* the cartilage is invisible, or nearly so.

1. TRIGONELLA PLANA, *Da Costa*. Tab. XXII, fig. 14, *a—c*.

- SPOONMUSCLE. *Petiver*. *Gazophylacium*, t. 94, fig. 3, cap. 54, 1764.
 CHAMA PIPERATA BELLONII. *Aldrov.* *Exsang.*, p. 471, 1623.
 TRIGONELLA PLANA. *Da Costa*. *Brit. Conch.*, p. 200, t. 13, fig. 11, 1778.
 — — *Desh.* *Expéd. Sci. Algérie Moll.*, pl. 44 to 64.
 — — *Lovén.* *Ind. Moll. Scand.*, p. 45, 1846.
 — — *Gray.* *List of Brit. Moll.*, p. 45, 1851.
 VENUS BOREALIS. *Penn.* *Brit. Zool.*, vol. iv, p. 96, pl. 48, fig. 28.

- MYA HISPANICA. *Chemn.* Conch. Cab., tom. vi, p. 31, t. 3, fig. 21, 1782.
 — ORBICULATA. *Speng.* N. H. S. Sk. H., i, p. 38, No. 13, sec. *Schum.*
 — GADITANA. *Gmel.* Syst. Nat., p. 3221, 1788.
 SOLEN CALLOSUS. *Olivi.* Zool. Adriat., p. 98, t. 4, figs. 1, A—C, 1792.
 MACTRA LISTERI. *Gmel.* Syst. Nat., p. 3261, 1788.
 — — *Woodw.* Geol. of Norf., p. 43, t. 2, fig. 7, 1833.
 — PIPERATA. *Gmel.* Syst. Nat., p. 3261, 1788.
 — COMPRESSA. *Mont.* Test. Brit., pp. 96 and 570, 1803.
 LIGULA COMPRESSA. *Mont.* Test. Brit. Supp., p. 23, 1808.
 TELLINA PLANA. *Don.* Brit. Shells, pl. 64, fig. 1, 1801.
 LUTRARIA COMPRESSA. *Lamk.* An. s. Vert., tom. v, p. 469, 1815.
 LISTERA COMPRESSA. *Turt.* Brit. Biv., p. 51, pl. 5, figs. 1, 2, 1822.
 LUTRICOLA COMPRESSA. *Blainv.* Malac., pl. 77, fig. 2, 1825.
 AMPHIDESMA COMPRESSUM. *Flem.* Brit. An., p. 432, 1828.
 — TRANSVERSUM? *Say.* Amer. Conch., pl. 28, mid. fig.
 LAVIGNON CALCINELLA. *Recluz.* Illust. Conch. p. 8, pl. 1, fig. 1.
 SCROBICULARIA ARENARIA. *Schum.* Essai d'un Nouv. Syst. des Vers., p. 127, pl. 8, fig. 3, a, b, 1817.
 — PIPERATA. *Phil.* En. Moll. Sic., vol. ii, p. 8, 1844.
 — — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 326, pl. 15, fig. 5; and pl. K, fig. 6, 1848.
 — PLANA. *Alder.* Cat. Moll. North. and Durh., p. 90, 1848.
 ABRA LISTERI. "*Leach,*" 1819. Ann. and Mag. Nat. Hist., 1847, vol. xx, p. 272.
 LA CALCINELLE. *Adans.* Senegal, p. 232, t. 17, fig. 18, 1757.

Spec. Char. Testá ovatá, transversá, compressá, subæquilaterali, concentricè striatá; cardine bidentato; sinu palliari magno, profundo.

Shell ovate, transverse, compressed, nearly equilateral, concentrically striated; hinge with two teeth; pallear sinus large and deep.

Length, $1\frac{1}{2}$ inch. *Height*, $1\frac{1}{8}$ inch.

Locality. (?) Red Crag, Sutton.

Mam. Crag, Bramerton, Chillesford.

Clyde Beds. Recent, Mediterranean, Britain, and Scandinavia.

One specimen only of this long-known and common recent species was found by myself, many years ago, and, I think, in the Red Crag at Sutton. I believe it is not rare in the neighbourhood of Norwich. As the living species is subject to considerable variation in its outward form, there is no difficulty whatever in finding the exact resemblance of our fossil among recent specimens. The habits of the living animal lead it almost exclusively to the estuary portion of the sea, which may perhaps be a reason why it has not been more frequently met with. I have obtained one specimen from Clacton, in association with *Unio*, *Cardium*, &c. There is a slight difference in the tumidity of the two valves, causing thereby a difference in the pallear impression, like that in some of the *Tellens*.

ABRA,* *Leach*. 1819.

TELLINA (sp.) *Poli*. 1791. *J. Sow*.
 LIGULA (sp.) *Mont*. 1803.
 AMPHIDESMA (sp.) *Lamk*. 1818.
 ABRA. *Risso*, 1826. *Gray*, 1851.
 MACTRA (sp.) *W. Wood*, 1825.

ERYCINA (sp.) *Phil*. 1836.
 SYNDOSMYA. *Recluz*, 1843. *Lovén*, 1846.
Forbes and Hanley, 1848.
 CUMMINGIA (sp.) *G. B. Sow*.

Generic Character. Shell thin, transversely elongate, more or less inequilateral; surface smooth, and in the recent state covered by an epidermis. Hinge furnished with one or two small cardinal, and two distinct lateral teeth; cartilage placed in an oblique, spoon-shaped process, projecting inward; ligament small, external.

Animal of the form of the shell, with the edges of its mantle disconnected throughout, and finely fringed; siphons sometimes very long, slender, and separated the entire length, with simple orifices; foot large, and somewhat geniculated or bent.

This genus is closely allied to the preceding one, the ligament and cartilage being distinctly separated; but it differs otherwise in the arrangement of the hinge, the shells of this group being furnished with distinct lateral teeth.

The shells are generally small, thin, and colourless, with an unequal degree of tumidity in the two valves on the posterior portion, and a difference in form, consequently, in the sinus of the mantle mark.

In the recent state, the species live in sand and mud, have a vertical range of 150 fathoms, and extend from the coast of Norway to the Mediterranean.

1. ABRA ALBA, *W. Wood*. Tab. XXII, fig. 10, *a*, *b*.

MACTRA ALBA. *W. Wood*. Linn. Trans., vol. vi, pl. 16, figs. 9—12, 1802.

— BOYSII. *Mont*. Test. Brit., p. 98, pl. 3, fig. 7, 1803.

TELLINA PELLUCIDA? *Broc*. Conch. Foss. Subap., p. 514, t. 12, fig. 8, mala.

AMPHIDESMA BOYSII. *Turt*. Brit. Biv., p. 53, pl. 5, figs. 4, 5, 1822.

— — *Smith*. Mem. Wern. Soc., vol. viii, p. 93.

— ALBUM. *Flem*. Brit. An., p. 432, 1828.

— SEMIDENTATA? *Scacchi*. Catalogue, p. 5.

ERYCINA RENIERI? *Phil*. En. Moll. Sic., vol. i, p. 12, t. 1, fig. 6.

SYNDOSMYA ALBA. *Recluz*. Rev. Cuv. Zool., p. 362, 1843.

— — *Lovén*. Ind. Moll. Scand., p. 44, 1846.

— — *Forb. and Hanl*. Hist. Brit. Moll., vol. i, p. 316, pl. 17, figs. 12—14, 1848.

LIGULA BOYSII? *Forbes*. Ægean. Invert., p. 180, 1843.

— ALBA. *Nyst*. Coq. Foss. de Belg., p. 93, pl. 3, fig. 14, 1844.

ABRA — *Gray*. List. Brit. Moll., p. 43, 1851.

* Etym. ἀβρός, thin, delicate.

Spec. Char. *Testá ovatá vel ellipticá, tenui, lævi, inæquilaterali; latere antico majiore, rotundato; latere postico angulato, subcarinato; dentibus lateralibus parvis, tenuibus; sinu palliari magno, profundo.*

Shell ovate or elliptical, thin, smooth, inequilateral; anterior side the larger, and rounded; posterior angulated, and obscurely carinated; lateral teeth small, thin; pallal sinus large and deep.

Length, $\frac{1}{2}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton, Bawdsey, Walton Naze.

Clyde Beds (*Smith*), Bracklesham (*Dixon*).

Recent, British and Scandinavian Seas.

This is abundant in the Coralline Crag, and, although a thin shell, I have found many specimens in the Red Crag at Bawdsey, some of which had the valves united. It differs from *A. tenuis* in being less equilateral, though it is more so than the succeeding species, *A. fabalis*, and on the siphonal side it preserves a sort of intermediate character between the two, being less pointed than the one but more so than the other. There is an unequal tumidity in the two valves, causing thereby an inequality in the pallal sinus. The striæ or lines of growth are somewhat more strongly marked in this than in the succeeding species.

2. ABRA FABALIS, *S. Wood*. Tab. XXII, fig. 12, *a, b*.

Spec. Char. *Testá ovatá, vel elongato-trapezoidali, inæquilaterali, tenui, fragili, lævi; latere antico longiore, rotundato; latere postico angulato; margine ventrali arcuato; dentibus lateralibus elongatis; foveâ ligamenti mediocre.*

Shell ovate, or elongately trapezoidal, inequilateral, thin, fragile, and smooth; anterior side the longer, and rounded; posterior angulated; ventral margin curved; lateral teeth thin and elongated; ligamental area moderate.

Length, $\frac{3}{4}$ inch. *Height*, $\frac{1}{2}$ inch.

Locality. Red Crag, Walton Naze.

This shell presents so great a difference to the preceding (*alba*) as to entitle it, in my opinion, to an isolated position; being more elongated and slender, with the posterior side more pointed, and it also is a thinner shell, with a more delicate and less pronounced dental apparatus; less elongated than *A. prismatica*, but intermediate between the two, differing, however, from *A. intermedia* in being much more inequilateral, that shell having the umbo nearly central, while in this one the anterior side is at least two thirds larger than the posterior one. Our shell somewhat resembles *Tellina longicollis*, Scacchi, *Erycina longicollis*, Philippi; but the hinge of that species is even more slender, with more elongated lateral teeth, and the support for the cartilage is smaller.

3. ABRA PRISMATICA, *Montague*. Tab. XXII, fig. 13, *a*, *b*.

| | | |
|-------------------------|--------------------------------|---|
| LIGULA PRISMATICA. | <i>Mont.</i> | Test. Brit. Supp., p. 23, pl. 26, fig. 3, 1808. |
| — | — | <i>Brown.</i> Illust. Conch., Gt. Brit., pl. 14, fig. 5, 1827. |
| — | — | <i>Forb.</i> Rep. Ægean. Invert., p. 181, 1843. |
| ABRA | — | " <i>Leach.</i> " <i>Lamk.</i> Hist. des An. s. Vert., tom. v, p. 492, 1818. |
| MYA | — | <i>Turt.</i> Conch. Dict., p. 103, 1819. |
| SYNDOSMYA | — | <i>Recluz.</i> Rev. Cuv. Zool., p. 367, 1843. |
| → | — | <i>Lovén.</i> Ind. Moll. Scand., p. 45. |
| — | — | <i>Forb.</i> and <i>Hanl.</i> Hist. Brit. Moll., vol. i, p. 321, pl. 17, fig. 15. |
| TELLINA STRICTA. | <i>Broc.</i> | Conch. Foss. Subap., p. 515, t. 12, fig. 3, 1817. |
| — | DONACIFORMIS. | <i>Nyst.</i> Rech. Coq. Foss. d'Anv., p. 5, pl. 1, fig. 17, 1836. |
| LIGULA | — | <i>Id.</i> Coq. Foss. de Belg., p. 92, pl. 4, fig. 9, 1843. |
| AMPHIDESMA PRISMATICUM. | <i>Turt.</i> | Brit. Biv., pl. 5, fig. 3, 1822. |
| ERYCINA ANGULOSA. | " <i>Bronn.</i> " <i>Phil.</i> | En. Moll. Sic., vol. ii, p. 9, 1844. |

Spec. Char. Testá elongato-ovatá, inæquilaterali, lævigatá, tenui; latere postico duplo breviorē; subrostrato; dentibus lateralibus elongatis.

Shell elongately ovate, inequilateral, smooth, and very thin; posterior side half the length of the anterior, and pointed; lateral teeth elongated.

Length, $\frac{3}{4}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

Clyde Beds.

Recent, Ægean, British, and Norwegian Seas.

I have met with this shell only in the Cor. Crag, and there not very abundantly. If there be any difference between this and the existing form, it is that the fossil appears rather the more tumid of the two. The ligamental area is small, and there are two small lateral denticles or dorsal elevations in the left valve, rather remote from the umbo, with one cardinal tooth; and two lateral denticles, and two cardinal teeth in the right valve; pallial impression not visible. The siphonal side is somewhat pointed and slightly compressed, forming an obscure angle or ridge on that side from the umbo to the posterior extremity. This species in the living state is said to have a vertical range of 100 fathoms, with a wide geographical extension from Norway to the Ægean, and there appears very little doubt that the fossil called *Erycina angulosa*, from the Upper Tertiaries of Calabria, belongs to the same species. It is found also in the Belgian Crag of Anvers. *Ligula fragilis*, Bosquet, 'Bull. de l'Acad. Roy.,' tom. xviii, pl. 11, p. 305, fig. 1, *a—d*, a shell from Klein Spauwen, strongly resembles our species, but it is, I believe with that author who has pointed out the differences between the Belgian shells, quite distinct. *Amphidesma subreflexa*, Conrad, p. 37, pl. 19, fig. 6, if one might judge from the figure alone, may perhaps be united with *A. prismatica*.

4. ABRA OBOVALIS, *S. Wood.* Tab. XXII, fig. 11.AMPHIDESMA OBOVALE. *S. Wood.* Catalogue, 1840.ERYCINA OVATA? *Phil.* En. Moll. Sic., vol. i, p. 13, t. 1, fig. 13, 1836.TELLINA RUBIGINOSA? *Poli.* Vol. i, p. 48, t. 15, fig. 31, 1791, sec. *Phil.*

Spec. Char. Testá ovatá, crassiusculá, subæquilaterali; anticè rotundatá, convexá; posticè angulatá, compressiusculá; dentibus lateralibus magnis, elevatis, approximatis; apicibus prominulis; impressione palliari magno profundo.

Shell ovate, rather thick, nearly equilateral, smooth; anterior side rounded, somewhat tumid; posterior angulated, and slightly compressed; lateral hinge teeth large, elevated, and proximate; apices rather prominent; palléal impression large and deep.

Length, $\frac{1}{2}$ inch nearly. *Height*, $\frac{3}{8}$ inch.

Locality. Red Crag, Sutton.

Mam. Crag, near Norwich.

Only two specimens of this species have come under my observation; one was from the Mam. Crag, given to me by Mr. Charlesworth, the other I found in the Red Crag at Sutton: they are both unfortunately the right valve. Perhaps the shell described by Philippi above referred to is the same species, but the figure is by no means good, and the description does not altogether accord with the Crag shell, which is thick, and not thin, as therein described; our shell has a remarkably thick hinge and a large, angular, or spoon-shaped area for the cartilage, behind which are two small cardinal teeth, and at a little distance are two prominent angular denticles; the posterior one close to the extremity of the hinge pit; the palléal sinus is very large, extending into the shell more than two thirds of its entire length. It differs from *A. tenuis* in being more pointed, and it has a more strongly marked hinge.

A shell much resembling this species has been obtained on the N. E. Coast of America, called *Cummingia tellinoides*, Conrad, 1830, Gould, 'Invert. Massach.,' p. 56, fig. 36, and Stimpson 'Catal.,' p. 20, but it is specifically distinct. The Crag shell is not so much compressed; the ventral margin is more convex, and the lateral teeth of the hinge larger and more prominent; while the American shell is also different externally, being covered with larger and more regular ridges.

Erycina ovata, Midden, t. 19, figs. 5—8, as well as *Amphidesma ovata*, Desh. 'Expéd. Morée,' pl. 6, fig. 8, appear, from the figures and descriptions, to be different from our shell.

MACTRA,* *Linnæus*, 1767.CALLISTA CALLISTODERMA (sp.) *Poli.* 1791.TRIGONELLA (sp.) *Da Costa*, 1778.MULINIA. *Gray*, 1836.SPISULA. *Gray*, 1837; 1851.MESODESMA (sp.) *Desh.* 1835.HEMIMACTRA. *Swains.* 1840.

* Etym. μακτρα, a kneading trough.

Generic Character. Shell transverse, subequilateral, equivalve; ovate, elliptical, or subtriangular, sometimes thin, occasionally thick and ponderous, slightly gaping laterally; surface smooth, or finely striated concentrically. Hinge with a double cardinal tooth in the left valve, and a triangular space for its reception in the right, with large and elongated lateral teeth on each side: a large triangular pit for the cartilage. Ligament small, external. Impression by the mantle sinuated.

Animal with its mantle freely open almost as far backward as the siphons; margins fringed; siphons large and extensile, united to their extremities, and the orifices ornamented with cirri; foot long and strong, tongue-shaped, geniculated.

This genus, constituting a well marked group, has not been much dismembered since the time of its original establishment by Linnæus: a division under the name of *Spisula*, has, however, been proposed by Dr. Gray for those species which have the ligament entirely hidden by the dorsal margin, and the more complete union of the cartilage with the ligament, and he has reserved the name of *Mactra* for the species which have a small shelly plate interposed between the two portions of the ligament, and where it is partially visible when the valves are closed; this distinction is so very ill defined that it is not thought necessary the separation should be here adopted. The most distinguishing character is the possession of a sharp diverging or chevron-formed tooth, somewhat resembling the letter \wedge reversed, and this is placed immediately beneath the umbo before the cartilage. Some of the species have the lateral teeth and the sides of the sockets, into which they are inserted, covered with rugosities or ridges in a direction at right angles to these teeth; others have these parts quite smooth; the thicker species are generally furnished with those ridges, but the thinner ones are not always free or naked: these might almost constitute a sectional distinction, but the same differences are observable in the genera *Astarte* and *Cyrena*.

The species of this genus have been found in most parts of the world, living principally in shallow water; they are generally buried in the sand, within a short distance from the surface.

In the fossil state they have been obtained in the Lias and Greensand formations, and one is recorded as from the Carboniferous series; but this latter is of doubtful character. The species, as well as individuals, are largely developed in the newer Tertiaries, and are abundant also at the present day.

1. MACTRA GLAUCA, *Born.* Tab. XXIII, fig. 2, *a, b.*

MACTRA GLAUCA. *Born.* Test. Mus. Cæs. Vind., p. 51, t. 3, figs. 11, 12, 1780.

— HELVA SEU HELVACEA. *Chemn.* Conch., Cab., vol. vi, p. 234, t. 23, figs. 232, 233.

— HELVACEA. *Payr.* Cat. Moll. Cors., p. 29, 1826.

— — *Phil.* En. Moll. Sic., vol. i, p. 10; vol. ii, p. 9.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 366, pl. 23, fig. 2, 1848.

— NEAPOLITANA. *Poli.* Test. Sicil., vol. i, t. 18, figs. 1—3, 1791.

Spec. Char. *Testá ovatá subtrigonulá, subinæquilaterali, tenui, lævi, compressiusculá; margine dorsali convexiusculo; dentibus lateralibus remotis, lævigatis, acutis, tenuibus; foveâ cardinali magnâ; sinu palliari semicirculari.*

Shell ovate, slightly trigonular, nearly equilateral, thin and smooth, somewhat compressed; dorsal margin slightly curved; lateral teeth remote, smooth, sharp, and thin; cartilage pit large; pallear sinus semicircular.

Length, $3\frac{1}{8}$ inches. *Height*, $2\frac{1}{2}$ inches.

Locality. Red Crag, Newbourn. Recent, Mediterranean, British Channel.

This species, in the recent state, seems restricted to the warmer parts of the British Seas, and to the Mediterranean, and as such we might have expected to have found it in the lower Crag deposit. Two specimens were found by myself in the genuine, though rather disturbed portion of the, Red Crag: there is, I think, little doubt of its having been an inhabitant of the sea of this latter Period, as so large and thin a species would hardly have escaped destruction in a removal from one formation to another. *M. stultorum* is the shell with which it is most likely to be confounded; that species, however, never attains to so great a magnitude. The dental characters in this are strongly marked; the right valve has two unequal sized cardinal teeth, the anterior one short, inside of which the Δ -formed tooth of the left valve interlocks; the lateral teeth are long, thin and sharp, rather less elevated towards the sides than are those of *M. stultorum*, and in this species the umbo is rather more prominent: the pit for the cartilage is of a triangular form, and the mantle sinus is comparatively less.

Born seems intitled to priority, as there is very little doubt his figure, though not a good one, was intended for this species, and to which Chemnitz (who has given a much better representation) has referred.

Menke has introduced this species into his 'List of New Holland Mollusca.' This Australia shell may be what is called by some authors its representative.

2. MACTRA STULTORUM, *Linnaeus*. Tab. XXIII, fig. 3, *a—d*.

MACTRA STULTORUM. *Gualteri*. Ind. Test. Conch., t. 71, fig. c, 1742.

PECTUNCULUS. *Leigh*. Nat. Hist. Chesh., pl. 3, fig. 6, 1700.

CARDIUM STULTORUM. *Linn*. Syst. Nat., ed. 10, p. 681, No. 8.

MACTRA STULTORUM. *Linn*. Syst. Nat., ed. 12, p. 1126, No. 99, 1767.

— — *Broc*. Conch. Foss. Subap., p. 535, No. 2, 1814.

— — *Phil*. En. Moll. Sic., vol. i, p. 10, t. 3, fig. 2, 1836.

— — *Forb. and Hanl*. Hist. Brit. Moll., vol. i, p. 362, pl. 22, figs. 4—6.

— CINEREA. *Mont*. Test. Brit. Supp., p. 35, 1808.

— MAGNA. *Woodw*. Geol. of Norf., p. 43, t. 2, fig. 10, 1833.

— STRAMINEA? *Desh*. 2d ed. *Lamk*. tom. vi, p. 100, 1835.

TRIGONELLA RADIATA. *Da Costa*. Brit. Conch., p. 196, pl. 12, fig. 3, 1778.

TELLINA RADIATA. *Penn*. Brit. Zool., ed. 4, vol. iv, p. 87, pl. 49, fig. 30.

Spec. Char. *Testá ovatá, transversá, subtrigóná, subæquilaterali, lævi, tenui; cardine bidentatá, dentibus lateralibus acutis, elongatis; sinu palliari semicirculari.*

Shell ovate, transverse, subtrigonal, slightly inequilateral, smooth, and thin; hinge with two cardinal teeth in each valve, with sharp and compressed lateral teeth; impression of the mantle with a semicircular sinus.

Length, $2\frac{1}{4}$ inches. *Height*, $1\frac{3}{4}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton.

Mam. Crag, Bramerton.

Clyde Beds, *Smith*; Bracklesham (*Dixon*).

Recent, Mediterranean and British Seas.

A fragment only of this species is in my cabinet from the lower or Coralline Crag, and it is not by any means abundant in the succeeding or Red Crag period, but it has been found plentifully in the Mammaliferous Crag, near Norwich, and in the Clyde beds, and it has become a very common shell in our own seas.

There is considerable variation among my specimens not only in proportionate dimensions but also in the outward form. In fig. *a* the shell is almost as high as it is long, with the dorsal edge rounded; fig. *b*, is comparatively much longer, with the hinder side angulated and somewhat pointed. The impressions of the adductors are rather large, and the sinus of the mantle-mark extends inwards about $\frac{2}{3}$ ths of the length of the shell. The lateral teeth are thin, double in the right valve, and the cardinal Δ -formed tooth diverges nearly at a right angle.

In the recent state it is littoral in its habits, and has a wide geographical range, extending from the south coast of Norway (*Forbes* and *Hanley*) into the Mediterranean, and it is mentioned by Philippi as having been met with by Ehrenberg in the Red Sea.

3. MACTRA ARCUATA, *J. Sowerby*. Tab. XXIII, fig. *a—c*.

MACTRA ARCUATA. *J. Sow.* Min. Conch., t. 160, fig. 1, 1817.

— — *Woodw.* Geol. of Norf., p. 43, 1833.

— — *Nyst.* Coq. Foss. de Belg., p. 78, pl. 11, fig. 7, 1844.

Spec. Char. *Testá ovato-trigonula, inæquilaterali, lævigatá, subcompressá, tenui; anticè latiore et breviorè, rotundatá; margine dorsali arcuató; cardine bidentato, dentibus lateralibus perpendiculariter striatis; sinu palliari linguiformi.*

Shell ovate, or rather ovato-trigonal, inequilateral, smooth, slightly compressed, thin; anterior side the broader, short, and rounded, dorsal margin curved; hinge with two cardinal teeth, and striated lateral teeth; pallial sinus tongue-shaped.

Length, $3\frac{1}{4}$ inches. *Height*, $2\frac{3}{8}$ inches.

Locality. Coralline Crag, Sutton, Gedgrave.

Red Crag, Walton Naze, Sutton, Bawdsey.

This species is not very abundant in the Coralline Crag; but in the native bed at Walton Naze in the Red Crag, specimens are met with in large numbers, although somewhat difficult to obtain perfect, owing to their extreme fragility. The exterior is always more or less ridged, from the unequal degree of decomposition, and the surface is never in its original condition; but, judging from those in which it is partially preserved, it was probably nearly smooth in the living state.

The ligamental area is large and simple, running close up to the umbo; and the cardinal \wedge -formed tooth very small in the left valve, with a corresponding cavity in the right; the lateral teeth are double in the right valve, deeply ridged on both sides of the interior; the lateral teeth of the left valve are single, and ridged on the outside; the muscular impressions are large, not very deep seated, and the sinus in the mantle-mark is somewhat narrow, extending into the interior at least one third of its entire length, but variable, being modified by the comparative length of the shell.

4. *MACTRA ARTOPTA*, *S. Wood*. Tab. XXIII, fig. 4, *a*, *b*.

Spec. Char. *Testá trigonulá vel obtusè cuneatá; tumidiusculá, inæquilaterali, anticè rotundatá, margine dorsali postico rectiusculo; umbonibus subprominulis: dentibus lateralibus perpendiculariter striatis.*

Shell trigonal or obtusely wedge-shaped, slightly tumid, inequilateral, anterior side rounded, dorsal margin of posterior side somewhat straight, umbones rather prominent, lateral teeth striated perpendicularly.

Length, $2\frac{1}{2}$ inches. *Height*, 2 inches.

Locality. Cor. Crag, Sudbourne.

Several specimens of a *Mactra*, contained in the collections of Mrs. Corder, Mr. Perry, and my own, appear to possess a uniformity of character, such as I think entitle them to be considered as belonging to a distinct species, differing from *M. arcuata*, which is perhaps its nearest relative, in having the dorsal margin less curved than in any specimens of that species which have come under my inspection. This shell is also rather more tumid, and it has a more elevated umbo, and its whole aspect appears different. I have seen it only from the Coralline Crag, in the neighbourhood of Orford. My specimens of *M. arcuata*, from the same Formation, were found at Ramsholt.

5. *MACTRA PROCRASSA*, *S. Wood*. Tab. XXIV, fig. 8, *a*, *b*.

Spec. Char. *Testá magná, crassá; irregulariter striatá, ovato-trigonulá, inæquilaterali; anticè sub-angulatá, posticè rotundatá; foveá ligamenti magná; dentibus lateralibus perpendiculariter striatis.*

Shell large, thick and strong; irregularly striated externally, ovately triangular; inequilateral; anterior side obtusely angulated, posterior rounded; ligamental area large; lateral teeth perpendicularly striated.

Length, $2\frac{1}{2}$ inches. *Height*, 2 inches.

Locality. Red Crag, Felixstow.

One specimen only of this species is all that I have seen. It is from the cabinet of Mr. Perry, and was obligingly forwarded to me for publication by Mrs. Corder.

It somewhat resembles *M. solidissima*, Chemn. (*M. gigantea*, Lamk.), but differs from that shell in being much more rounded on the posterior side. The lateral teeth in our shell are also considerably larger, and the sinus in the mantle-mark is also different; but that perhaps may depend upon, or would be modified by, the length and form of the posterior side. A shell in the British Museum, from South America, *M. exalbida*, much resembles it in form, but in this latter species the lateral teeth are smooth.

6. MACTRA TRUNCATA, Montague. Tab. XXIV, fig. 2, *a*, *b*.

PECTUNCULUS CRASSIUSCULUS. *List.* Hist. Conch., lib. 11, fig. 87.

MACTRA TRUNCATA. *Mont.* Test. Brit. Supp., p. 34, 1808.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 354, pl. 23, fig. 1.

— SUBTRUNCATA. *Donov.* Brit. Shells, vol. iv, pl. 126, 1803.

— CRASSATELLA. *Desh.* 2d ed. *Lamk.* tom. vi, p. 107, No. 33, 1835.

— CRASSA. *Turt.* Brit. Biv., pp. 69, 258, t. 5, fig. 7, 1822.

SPISULA — *Gray.* Mag. Nat. Hist., new series, vol. i, p. 373, 1837.

Spec. Char. Testâ rotundato-triangulatâ, subæquilateralî crassâ; sinu palliari brevî, linguiformi; umbonibus prominentibus, dentibus lateralibus perpendiculariter striatis.

Shell roundedly triangular, subequilateral, thick; pallear sinus short, tongue-shaped; umbones prominent, lateral teeth with perpendicular striæ or ridges.

Diameter, $1\frac{1}{4}$ inch.

Locality. Red Crag, Sutton, Walton Naze.

Clyde Beds.

Recent, Britain, and Scottish Seas.

This is at present a rare Crag species. A worn and somewhat injured specimen has long been in my possession; two others, in better condition, have since been obtained by Mrs. Corder, and these are all that I have seen.

7. MACTRA SOLIDA, Linnæus. Tab. XXIV, fig. 4, *a*—*c*.

MACTRA SOLIDA. *Linn.* Syst. Nat., ed. 12, p. 1126, 1766.

— — *Goldf.* Petr. Germ., vol. ii, p. 253, No. 1, t. 152, fig. 5.

— — *Phil.* En. Moll. Sic., vol. i, p. 11; vol. ii, p. 10.

— — *Nyst.* Conch. Foss. de Belge., p. 77, pl. 3, fig. 10, 1844.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 315, pl. 22, figs. 1—5, 1848.

MACTRA VULGARIS. *Chemn.* Conch. Cab., vol. vi, p. 230, pl. 23, fig. 229.

TRIGONELLA ZONARIA. *Da Costa.* Brit. Zool., p. 197, pl. 15, fig. 1, 1778.

— GALLINA. *Id.* Brit. Zool., p. 199, pl. 14, fig. 6.

SPISULA SOLIDA. *Gray.* Mag. Nat. Hist., 1837, p. 374.

Spec. Char. Testá ovato-trigonalí, subæquilaterali, crassá, læviusculá; dentibus lateralibus perpendiculariter striatis.

Shell triangularly ovate, slightly inequilateral, thick, nearly smooth; lateral teeth perpendicularly striated.

Length, 1 inch. *Height*, $\frac{7}{8}$ inch.

Locality. Red Crag, Sutton.

Mam. Crag, Bramerton.

Clyde Beds.

Recent, Mediterranean and British Seas.

As far as I can ascertain the history of this species, it is of comparatively modern origin, although by some mistake it was quoted in my 'Catalogue' as from the Older or Coralline Crag, from which deposit I certainly have not a well-determined specimen, and those from the succeeding or Red Crag Period are somewhat doubtful.

I have one characteristic specimen from Bramerton, corresponding precisely with the common living shell, but it does not appear to have been abundant even there, as it is not enumerated among the Norfolk Shells by Woodward.

In the recent state, it is generally a littoral species, living buried in the sand, but has been found in water as deep as thirty-five fathoms (*M'Andrew*). It is an estuary species at the present day.

8. MACTRA OVALIS, *J. Sowerby.* Tab. XXIII, fig. 1, *a—d*.

MACTRA OVALIS. *J. Sow.* (not *Gould.*) Min. Conch., t. 160, fig. 5, 1817.

— DUBIA. *Id.* Min. Conch., t. 160, figs. 2, 3, 4.

— ELLIPTICA. *Brown.* Illust. Conch. Gt. Brit., pl. 15, fig. 6, 1827.

— — *Lovén.* Ind. Moll. Scand., p. 45, 1846.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 356, pl. 22, fig. 3.

— SOLIDA. *Don.* Brit. Shells, t. 61, small figure.

— CONGESTA? *Conrad.* Foss. of the Med. Tert., p. 27, pl. 15, fig. 2, 1838.

— STRIATA. *Nyst.* Coq. Foss. de Belg., p. 80, pl. 4, fig. 1 *a*, 1844.

SPISULA ELLIPTICA. *Gray.* List Brit. Moll., p. 32, 1851.

Spec. Char. Testá ellipticá vel ovato-angulatá, subæquilaterali, lævigatá, vel tenuissimè striatá, tumidiusculá; dentibus lateralibus rugosis; margine ventrali arcuato.

Shell elliptical or angularly ovate, nearly equilateral; smooth or very finely striated transversely; slightly tumid; lateral teeth rough or striated; ventral margin curved.

Length, 2 inches. *Height*, $1\frac{1}{2}$ inch.

Locality. ? Cor. Crag, Sutton.

Red Crag, Bawdsey, Sutton, Woodbridge.

Mam. Crag, Bramerton, Chillesford.

Clyde Beds.

Recent, Finmark, Britain.

The name of *ovalis* is selected in preference to that of *dubia*, as being best suited to the character of the species, both having been proposed at the same time.

A considerable range in variation is observable in the numerous specimens found in the Red Crag, some of which very closely approach *M. solida*, so much so that I was induced to consider it in my 'Catalogue' only as a variety, more especially as in this, when perfect, the dorsal portion is marked with ridges such as are supposed to be a good distinguishing character for that species. The principal difference appears to be a greater solidity of substance in the one so named, and the other is of course thinner. Our Red Crag fossil has the exterior covered with very fine, close-set, and rather irregular striæ, while upon the upper or dorsal portion it is more strongly ridged than is usual in the recent shell. The variety *M. dubia* is less elliptical, with the dorsal portion ridged, connecting it in that character with *M. solida*, from which it differs only in being rather more oval and thinner.

In the Red Crag this is one of the most abundant shells, and may be obtained in most localities; but I have never found it at Walton-on-the-Naze.

9. MACTRA SUBTRUNCATA, *Da Costa*. Tab. XXIV, fig. 3, *a, b*.

TRIGONELLA SUBTRUNCATA. *Da Costa*. Brit. Conch., p. 198, 1778.

MACTRA SUBTRUNCATA. *Mont.* Test. Brit., p. 93, and Sup., p. 37, pl. 27, fig. 1.

— — *Lovén*. Ind. Moll. Scand., p. 45, 1846.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 358, pl. 21, fig. 8; pl. 22, fig. 2; and pl. 1, fig. 3, 1848.

— — ? *Midd.* Malac. Rossic., p. 581, t. 18, figs. 11—13.

— — *Sismonda*. Syn. Meth. Anim. Invert. Ped. Foss., p. 22, 1847.

— CUNEATA. *J. Sow.* Min. Conch., t. 160, fig. 7, 1817.

— — *Woodw.* Geol. of Norf., p. 43, t. 2, fig. 10, 1833.

— EUXINICA? *Krynichi.* Bull. des Not. de Moscou, No. 11, p. 63, 1837.

— LIMBATA. *Menke.* Fide *Lovén*.

SPISULA SUBTRUNCATA. *Gray.* Mag. Nat. Hist., new series, p. 374, 1837.

Spec. Char. Testâ ovato-triangulari, vel cuneiformi, inæquilaterali, crassâ; anticè breviorè subtruncatâ; posticè producta, angulatâ; dentibus lateralibus perpendiculariter striatis; margine ventrali convexiusculo.

Shell ovately triangular or obtusely wedge-shaped, inequilateral, thick; anterior side the shorter, and roundedly truncate; posterior side produced, and angulated; beaks slightly prominent; lateral teeth perpendicularly striated; ventral margin slightly convex.

Length, 1 inch. *Height*, $\frac{3}{4}$ inch.

Locality. Red Crag, Sutton?

Mam. Crag, Bramerton.

Clyde Beds, Bracklesham, Uddevalla.

Recent, West Gothland, Britain, Mediterranean.

This is a common shell in the Mammaliferous Crag in the neighbourhood of Norwich. The cuneiform variety (*cuneata*) differs only in so far as to have one side a little more produced than is usual in the recent shell. The specimens are always more or less deprived of their outer coating; but in those best preserved, the ridges upon the dorsal area may be distinctly seen.

10. *MACTRA OBTRUNCATA*, *S. Wood*. Tab. XXIV, fig. 5, *a*, *b*.

Spec. Char. *Testá subæquilaterali, obtusè triangulari, obtruncatá; anticè angulatá; posticè truncatá aut rotundatá; umbonibus subprominentibus; areá dorsali striatá; dentibus lateralibus rugosis.*

Shell slightly inequilateral, obtusely triangular, roundedly truncate; anterior side angular, posterior irregularly rounded; umbones slightly prominent; dorsal area striated; lateral teeth denticulated.

Length, $\frac{7}{8}$ inch, nearly. *Height*, $\frac{3}{4}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton.

This shell is not rare either in the Red or Coralline Crag. It much resembles in form the preceding species (*M. subtruncata*), but differs essentially in being reversed. In the living species the angular or produced portion is on the side on which the ligament is placed, and where the sinuated mark of the mantle is seen; while in this, the anterior side is angulated, though not much produced. It is a thick and strong shell, somewhat tumid, with an obtuse ridge on each side, more distinctly marked on the anterior, running from the umbo to the ventral margin, within which it is slightly flattened. It has long remained in my cabinet, under the name of *M. subtruncata*, imagining it to have been only a reversed variety, like *Trophon antiquum*, var. *contrarium*, so common in the Red Crag. There appears, however, a difference also in the form and direction of the sinus in the mantle-mark, more than might be the result of a difference in the length of the siphonal sides of the two shells.

Mactra striata, Smith, 'Wern. Trans.,' vol. viii, pl. 1, fig. 22, much resembles, and may probably prove to be, this species, but I have not been able to obtain a specimen for comparison; and judging from the representation, it does not appear to have the angular form on the anterior side as in our shell. Messrs. Forbes and Hanley referred

the Stevenston shell to *M. subtruncata*, but Mr. Smith tells me it does not belong to that existing British species.

I have, therefore, proposed the above name for the Crag fossil, not only from the state of uncertainty respecting *M. striata*, but also from the consideration of the name being employed for another species.

11. *MACTRA CONSTRICTA*, *S. Wood.* Tab. XXIV, fig. 6, *a—c.*

Spec. Char. *Testá oblongo-ovatá, inæquilaterali, crassá, lævigatá vel tenuissimè striatá; anticè longiore, rotundatá, posticè angulatá; margine ventrali constricto; dentibus lateralibus perpendiculariter striatis.*

Shell ovately oblong, inequilateral, thick, smooth or finely striated concentrically; anterior side the longer, and rounded; posterior angulated; ventral margin contracted; lateral teeth rough or perpendicularly striated.

Length, $1\frac{1}{4}$ inch. *Height*, $\frac{5}{8}$ inch.

Locality. Red Crag, Sutton.

This is a common shell, and very abundant in some localities. In its adult state it assumes a form somewhat approaching *M. deaurata*, the ventral margin on the siphonal side, after a certain period of growth, becomes contracted or constricted, and the dorsal margin then slopes suddenly, giving it an angular form. In the young shell, as indicated by the lines of growth, it has the oval shape of *ovalis*, and I considered it as a variety only of that species; but in many of the species of this genus it is very difficult to determine to which the immature shell belongs, and I have now reason to believe this to be entitled to specific distinction. *Macra Caspia*, Eichwald (a Tertiary fossil), 'Fauna Caspio-Caucasia, p. 261, t. 38, figs. 21, 22, has some resemblance to our shell; but it appears to be more equilateral, and too regular in form, without the contraction or distortion of the Crag specimens.

I have been unable to obtain any information respecting the specimen figured by Woodward, called *M. triangularis*, 'Geol. of Norf.,' t. 2, fig. 9, though most obligingly aided in the search by my collecting friends in Norwich.

12. *MACTRA DEAURATA*, *Turton.* Tab. XXIV, fig. 7, *a, b.*

MACTRA DEAURATA. *Turt.* Brit. Biv., p. 71, t. 5, fig. 8, 1822.

— *DENTICULATA.* *W. Wood.* Ind. Test. Supp. *Macra*, pl. 1, fig. 9.

— *MODICELLA?* *Conrad.* Sillim. Journ., vol. xxiii, p. 340.

— — *Id.* Foss. Med. Tert., p. 25, pl. 13, fig. 3, 1838.

— *INEQUILATERA.* *Nyst.* Conch. Foss. Belg., p. 79, pl. 11, fig. 8, 1844.

- MESODESMA JAURESII. *De Joannis.* Mag. de Zool. Moll., pl. 54, 1834.
 — — *Gould.* Invert. Massach., pl. 58, fig. 38, 1841.
 — DEAURATA. *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 346, 1848.
 ERYCINA DENTICULATA. *Cuvier. (Griffiths.)* An. Kingd., t. 22, fig. 2.
 PAPHIA DEAURATA. *Gray.* List Brit. Moll., p. 157, 1851.

Spec. Char. Testá transversá, oblongo-ovatá, inæquilaterali, crassa; transversè striatá vel subimbricatá; anticè longiore et rotundatá; posticè truncatá; cardine bidentato; dentibus lateralibus magnis, striatis.

Shell transverse, ovately oblong, inequilateral, thick and strong, transversely or concentrically striated; anterior side the longer, and rounded; posterior truncated; lateral teeth large, and perpendicularly striated.

Length, $1\frac{1}{4}$ inch. *Height*, $\frac{3}{4}$ inch.

Locality. Red Crag, Sutton, Walton Naze.

Recent, North-east Coast of America, Newfoundland.

The specimen figured was found at Walton-on-the-Naze by John Brown, Esq., of Stanway. There is another in my own cabinet, from the Red Crag at Sutton, but not in quite so good a state of preservation. It may be thus more fully described: The anterior side is much produced, the base line of the shell ascending towards the extremity, where it is roundedly pointed, while the siphonal side is very short, and obtusely biangulated; the surface is covered with irregularly elevated lines of growth or ridges; corresponding with the figure and description given by Turton, who says it somewhat resembles in outline *M. dealbata*, but differs in being thicker, and also in the teeth, though he does not tell us what these latter are like in either species.

The recent shell is placed by some authors in the genus *Mesodesma*. A small Δ -formed tooth is present in this left-hand specimen, placed immediately before a large ligamental area, as in *Mactra*, with elongated lateral teeth, which are striated.

LUTRARIA,* *Lamk.* 1799,

MACTRA (sp.) *Linn.*

PSAMMOPHILA. *Leach*, MS. 1819. Fide *Brown*.

LUTRICOLA (sp.) *De Blainv.* 1824.

Generic Character. Shell transversely ovate or oblong, inequilateral, and gaping at the lateral extremities; externally smooth, or slightly striated transversely. Hinge with a prominent triangular or diverging tooth in the right valve, with a corresponding pit for its reception in the left. Ligament internal, placed in a large spoon-shaped depression in each valve. Impression by the mantle deeply sinuated.

* Etym. *Lutra*? a luto, to daub, probably from its mud-like exterior.

Animal oblong, with very elongated siphonal tubes united almost to their extremities; orifices fimbriated. Mantle open in front for the emission of a foot of considerable size.

The true position of this genus (or what is called its family connexions) is still a subject of much diversity of opinion, some placing it near to *Mya*, while others claim for it a close affinity to *Mactra*.

Few species of this genus are at present known in the recent state, and as fossils they have been recorded in the Older Secondary Formations. The true generic position of the latter is doubtful. In the Older Tertiaries it does not appear to have been found, but the middle and newer Formations contain about nine or ten species.

LUTRARIA ELLIPTICA, Lamarck. Tab. XXIV, fig. 1, *a*, *b*.

- MACTRA LUTRARIA. *Linn.* Syst. Nat., ed. 12, p. 1126, No. 101, 1767.
 — — *Brocchi.* Conch. Foss. Subap., p. 536, 1814.
 LUTRARIA ELLIPTICA. *Lamk.* Hist. des An. s. Vert., tom. v, p. 468, No. 2, 1818.
 — — ? *Basterot.* Foss. de Bord., p. 94, 1825.
 — — *Phil.* Enum. Moll. Sic., vol. i, p. 9; vol. ii, p. 7.
 — — *Desh.* Exp. Sci. Alger. Moll., pls. 33, 35, 36.
 — — *Sismonda.* Syn. Method. An. Inv. Ped. Foss., p. 23, 1847.
 — — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 270, pl. 12.
 — — *Nyst.* Conch. Foss. de Belg., p. 75, 1844.
 — — ? *Gratel.* Cat. Zool. de Terr. Tert. de la Gironde, p. 76, 1838.
 — VULGARIS. *Flem.* Brit. An., p. 464, 1828.
 Lister. Hist. Conch. Lib., 111, fig. 259.

Spec. Char. Testá ovato-oblongá vel ellipticá, inæquilaterali, læviusculá, anticè subangulatá, utrinque hiantè; sinu palliari profundo.

Shell ovately oblong or elliptical, inequilateral, somewhat smooth; anterior side the shorter, and slightly angulated; gaping at both extremities; pallial sinus deep.

Length, $5\frac{1}{4}$ inches. *Height*, 3 inches, nearly.

Locality. Cor. Crag, Sudbourn and Ramsholt.

Red Crag, Sutton.

Clyde Beds, and Irish and Lancashire Drift Beds. (*Forbes.*)

Recent, Mediterranean, Britain.

This fine, handsome shell is, I believe, not very rare at Sudbourn, though specimens of it are difficult to obtain. My cabinet contains one individual, with the two valves united, which I found at Ramsholt. There is a slight difference in our fossil, varying somewhat in its outline, more especially on the anterior or shorter side. In the recent shell, the dorsal portion is there more convex or rounded; but in the Crag specimen, this part is nearly straight, giving an angular form to that side; this difference, however, does not appear sufficient to affect the specific assignment. Each valve has a

large angular-formed or spoon-shaped depression for the ligament, before which, and immediately beneath the umbo, is a prominent \wedge -formed tooth in the right valve, which fits into an angular depression in the left. The comparative dimensions are somewhat variable, like what is observable in the living shell.

The habitat of the living animal is said to be in oozy sand, or muddy bottoms, varying in depth from six to twelve fathoms.

MACHA, *Oken*. 1815.

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| CHAMA (golar). <i>Adanson</i> . | PSAMMOBIA (sp.) <i>Turt.</i> 1822. |
| HYPOGÆA HYPOGÆODERMA (sp.) <i>Poli</i> , 1791. | SOLECURTUS (sp.) <i>Blainv.</i> 1824. |
| SILICUARIA (part). <i>Schum.</i> 1817. | NOVACULINA? <i>Benson</i> , 1830. |
| ADASIUS. <i>Leach</i> , MS. Fide <i>Gray</i> . | CYRTOSOLEN. <i>Herrm.</i> 1847. |
| PSAMMOSOLEN. <i>Bronn.</i> 1831. | MACHA. <i>Agass.</i> 1839. <i>Gray</i> , 1851. |

Generic Character. Shell transverse, of a somewhat oblong form, compressed in the middle, equivalved, equilateral; rounded and gaping at both extremities; surface generally ornamented more or less with oblique grooves or striæ. Hinge composed of two diverging teeth in one valve, and one in the other, with a large fulcrum for an external ligament. Impression of the mantle deeply sinuated.

Animal oblong, large and thick, mantle widely open in front for the passage of a large tongue-shaped foot. Siphons long, deeply separated, but united at their bases.

This has been justly separated from the *Solens*, on account of the different position of the hinge, though in its habits there is great similarity, and it is capable of burying itself rapidly in the sand.

Fossils, probably belonging to this genus, have been obtained from the middle Secondary Period.

MACHA STRIGILLATA, *Linnæus*. Tab. XXV, fig. 3, *a*, *b*.

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| SOLEN STRIGILLATUS. | <i>Linn.</i> | Syst. Nat., ed. 12, p. 1115, No. 30, 1767. |
| — | — | <i>Chemn.</i> Conch. Cab., vol. vi, t. 6, figs. 41, 42. |
| — | — | ? <i>Poli.</i> Test. utriusq. Sic., vol. i, p. 21, t. 12, fig. 1. |
| — | — | <i>Phil.</i> Enum. Moll. Sic., vol. i, p. 5. |
| — | CANDIDUS? | <i>Broc.</i> Conch. Foss. Subap., p. 497. |
| PSAMMOBIA STRIGILLATA. | <i>Turt.</i> | Brit. Biv., p. 97, t. 6, fig. 13, 1822. |
| SOLECURTUS STRIGILLATUS. | <i>Phil.</i> | Enum. Moll. Sic., vol. ii, p. 5, 1841. |
| MACHA STRIGILLATA. | <i>Gray.</i> | List Brit. Moll., p. 61, No. 1, 1851. |
| HYPOGÆA VARIEGATA. | <i>Poli.</i> | Test. Sicil. utriusq., vol. ii, p. 257. |

Spec. Char. Testâ ovato-oblongâ, subæquilaterali, utrinque rotundatâ, in mediâ compressâ, coarctatâ; dimidiam striatam, striis subobliquis insculptis.

Shell ovately oblong, rounded at both extremities, slightly inequilateral, compressed in the middle, with a small contraction in the ventral margin; one half covered with oblique striæ.

Length, 2 inches.

Locality. Cor. Crag, Sutton.

Recent, Britain? Mediterranean.

My specimens are few and fragmentary. They appear to possess about twenty-two divergingly imbricated ridges, or lines, covering about two thirds of the shell. These lines are vertical in the centre, one or two sloping a little towards the anterior.

There are the remains of colour in my specimens, and they correspond in that respect with what the British conchologists consider to be distinct, and different from the white variety, which is ornamented with the same kind of sculpture. The lines on my fossil do not appear to extend quite so far upon the anterior side as in the recent shells, but there is little doubt of its identity with either this or *M. candida*. Philippi gives both as inhabitants of the Mediterranean, as well as fossil in that part of the world, distinguishing the two species in the fossil state by the number of rays. This, I am afraid, is a questionable distinction; specimens of the red variety may be observed, on which may be counted the same number he has given to each species.

In that extraordinary book, Pontoppidon's 'Nat. Hist. of Norway,' p. 165, there is the figure of a shell called the smaller mussel, which is one of the varieties of this species, but it is not enumerated by Lovén in his 'Ind. Moll. Scand.' The shell from the Older Tertiaries, *Solen strigillatus*, Lamarck, 'Ann. du Mus.' t. 12, pl. 43, fig. 5, is distinct; the one referred to by Basterot (p. 96), from the neighbourhood of Bordeaux. I have not seen.

SOLENA,* *Arist., Linn., &c.*

SOLENA. *Browne*, 1756.

HYPOGÆA and HYPOGEODERMA (sp.) *Poli*, 1791.

SOLENARIUS? *Dumeril*, 1806.

VAGINA. *Megerle*, 1811.

ENSIS. *Schum*, 1817. *J. Sow.* 1846. *Gray*, 1851.

ENSATELLA. *Swains.* 1840.

Generic Character. Shell equivalved, transverse, linear, subcylindrical, straight or very slightly curved, gaping widely at both extremities, dorsal and ventral margins nearly parallel, umbones near the extremity. Hinge with two teeth in one valve, and one in the other, with sometimes a linear lateral tooth. Muscular impressions dissimilar. Pallial sinus short and wide. Ligament external, attached to an elongated fulcrum. In the recent state, covered with a thick epidermis.

* Etym. σωλην, a tube.

Animal narrow, and more or less cylindrical, with the mantle united at the borders, except in front, where it is open for the passage of a large and truncated foot. Siphons short and united, their margins fimbriated.

The generic character is here intended for the reception of those species known under the familiar appellation of Razor Shells, of a form resembling the handle of our common razors. A few modern authors still consider that the differences possessed by some of the shells of this peculiar form entitle them to a further division, and have united, under the name of *Ensis*, proposed by Schumacher, the species which possess a lateral tooth or lamina, and reserving to *Solen* those only in which this linear or transverse appendage is wanting.

The hinge of this genus is more anterior than that of any of the Bivalves, being situated at the extremity of the shell. Probably a more than usual strength of union for the two valves was required at this part to resist the action of its large and powerful foot, in consequence of the burrowing habits of the animal.*

This appears a modern genus, no true species having as yet been described as belonging to any Formation more ancient than the Lower Tertiaries, where some of the species deviate slightly from the type, the hinge not being quite at the extremity. The few shells somewhat of this form, found in the Palæozoic Rocks, are very doubtful *Solens*.

1. SOLEN GLADIOLUS, Gray. Tab, XXV, fig. 8, a—c.

SOLEN GLADIOLUS. Gray. Zool. of Beechey's Voy., p. 153, t. 43, figs. 4, 4, 1839.

— ENSIS var. MAJOR. Nyst. Coq. Foss. de Belg., p. 44, pl. 1, fig. 3, a, b, 1844.

ENSIS COMPLANATUS. J. Sowerby. Min. Conch., t. 642, figs. 2, 4.

Spec. Char. Testá elongatá, rectá, lævigatá; extremitate anticá obtusè truncatá; in valvá sinistrá unidentato, in alterá bidentato; dentibus lateralibus elongatis, marginatis.

Shell lineal or subcylindrical, straight and smooth, anterior extremity obtusely truncated; one cardinal tooth in the left valve, and two in the other; lateral teeth marginal.

Length, 5 inches. *Height*, 1 inch.

Locality. Red Crag, Walton Naze and Suffolk.

Recent, Arctic Seas.

* Some confusion has existed respecting the anterior and posterior sides of these shells. Poli has given a good and correct representation of one of the species of this genus, with its foot protruded at the anterior, and the siphons at the opposite extremity. In the 'Ency. Method.,' vol. iii, pl. 312, fig. 4, the *Solen* is depicted with the siphons at the anterior side; and in pl. I of the 'Hist. of Brit. Moll.,' all the animals are there represented as having the foot on the posterior or ligamental side of the shell. This is evidently the result of haste, or of the too numerous avocations of the late much lamented and talented author of the Malacological portion of that beautiful work, preventing the bestowal of a necessary attention for the avoidance of these trifling errors.

Fragments of this species are by no means rare, and pervade the whole of the Red Crag Deposit. The specimen figured is one of a pair of valves found in situ at Walton Naze, but in a very fragile condition, and much reduced in substance. The fragments from Suffolk display, generally, a greater solidity in the anterior portion, which is that most commonly obtained.

Much importance has been placed upon differences in proportional dimensions. In this, the length is about five times that of its height, while in *S. siliqua* some specimens are as one to eight. The greatest difference appears to be in the impression of the margins of the mantle; in this it is more inward, or further from the anterior edge, and, on the contrary, the more linear shell (*S. siliqua*) has the impression nearer the extremity, with a slight difference also in the form of the anterior adductor. The truncation of this extremity generally forms an angle of about 95° , but this is not constant; and I am inclined to believe (although they are here separated in deference to the recent conchologists, who have better materials to work upon) that the two forms are merely varieties of one and the same species, the differences of locality and other conditions producing all the variations shown by the two shells.*

2. SOLEN SILIQUA, *Linnaeus*. Tab. XXV, fig. 7, *a—e*.

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| SOLEN SILIQUA. | <i>Linn.</i> | Syst. Nat., ed. 12, 1113, No. 34, 1767. |
| — | — | <i>Poli.</i> Test. Sicil., vol. i, pl. 10, figs. 7—11. |
| — | — | <i>Turt.</i> Brit. Biv., p. 80, pl. 6, fig. 5, 1822. |
| — | — | <i>Phil.</i> En. Moll. Sic., vol. i, p. 4; vol. ii, p. 5. |
| — | — | <i>Forb. and Hanl.</i> Hist. Brit. Moll., vol. i, p. 246, pl. 14, fig. 3. |
| — | NOVACULA. | <i>Mont.</i> Test. Brit., p. 47, 1803. |
| — | LIGULA. | <i>Turt.</i> Brit. Biv., p. 82, pl. 6, fig. 6. |
| — | MAJOR. | <i>List.</i> Hist. Conch., lib. iii, fig. 255. |

Spec. Char. *Testá lineari, rectá, lævigatá; extremitate subtruncatá non marginatá; in valvâ sinistrâ unidentato, in alterâ bidentato; dentibus lateralibus elongatis.*

Shell linear or cylindrical, straight and smooth; extremity truncated, not marginated; one cardinal tooth in the left valve, and two in the other; lateral teeth elongate.

Length, 5 inches. *Height*, $\frac{3}{4}$ inch.

* It is possible that a portion of the Red Crag of Suffolk may have been derived from the destruction of the Older or Coralline Crag Formation, intermixed with the exuvæ of animals belonging to the seas of the former period, as well as with other extraneous fossils. The cliff at Walton Naze, however, affords strong presumptive evidence that the whole of the Red Crag is not derivative, and that the animals whose remains are there deposited, lived and died in the spot where they are now found. Bivalves are frequently obtained in this locality with the two portions united, and it seems scarcely possible that such a specimen as the above could have been removed out of one Formation to have been deposited, with its two fragile valves in their natural position, in the mud or sand of a succeeding period.

Locality. Red Crag, Sutton.
Clyde Beds, and Irish Drift.

Recent, Mediterranean, Britain.

This shell, I believe, has not been met with in the Coralline Crag: in the Red Crag it is not by any means abundant, and always in a fragmentary state. In my best-preserved specimen, the anterior termination is rather more rounded than that of the recent species to which it is assigned, but I have not enough to say if such be a constant character.*

3. *SOLENSIS*, *Linnaeus*. Tab. XXV, fig. 6, *a—f*.

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|-----------|-----------------------------|--|
| SOLENSIS. | <i>Linn.</i> | Syst. Nat., ed. 12, p. 1114, No. 35, 1767. |
| — — | <i>Poli.</i> | Test. Sicil., vol. i, p. 18, t. 11, fig. 14, 1791. |
| — — | <i>Broc.</i> | Conch. Foss. Subap., p. 479, 1814. |
| — — | <i>Gould.</i> | Invert. Massach., p. 29, 1841. |
| — — | <i>Desh.</i> | Exp. Scient. Alger., p. 184, pl. 11, figs. 1—4. |
| — — | <i>Nyst.</i> | Coq. Foss. Belg., p. 44, pl. 1, fig. 4, <i>a, b</i> , 1844. |
| — — | <i>Loven.</i> | Ind. Moll. Scand., p. 49, 1846. |
| — — | ? <i>Grateloup.</i> | Cat. Zool. Invert. Gironde, p. 68, No. 819, 1838. |
| — — | <i>Sismonda.</i> | Syn. Ped. Foss. Invert., p. 23, 1847. |
| — — | <i>Forb. and Hanl.</i> | Hist. Brit. Moll., vol. i, p. 250, pl. 14, fig. 2, 1848. |
| — | CURVUS. <i>List.</i> | Hist. Conch., t. 311, fig. 257. |
| — | ENSIFORMIS. <i>S. Wood.</i> | Catalogue, 1840. |
| — — | <i>J. Sowerby.</i> | Min. Conch., t. 642, fig. 1. |
| — — | ? <i>Conrad.</i> | Foss. Med. Tert., p. 76, pl. 43, fig. 8, 1845. |
| — | HAUSMANNI ? <i>Goldf.</i> | Pet. Germ., vol. ii, p. 277, pl. 159, fig. 6, <i>a—c</i> , 1842. |

Spec. Char. *Testá linearí, arcuatá, extremitate anticá curvatá, non marginatá; in valvá sinistrá unidentato, in alterá bidentato.*

Shell linear, curved, anterior extremity rounded, not margined; one cardinal tooth in the left valve, and two in the right.

Length, 3 inches. *Height*, $\frac{1}{2}$ inch.

Locality. Cor. Crag, Sutton, Ramsholt, Sudbourn.
Red Crag, Sutton, Walton Naze.
Irish Drift (*Forbes*).

Recent, N. E. Coast of America, Brit. Seas, Mediterranean, Sea of Okhotsk (*Middendorf*).

This species first appears in the Coralline Crag, where it is not very abundant;

* Since the above was written, I have obtained an imperfect specimen (fig. 7, *a, b*) of what appears to belong to this species, judging from its linear character, in which the muscular impressions are, like those of *S. gladiolus*, at a greater distance from the anterior margin, and which I first imagined to be a tangible distinction. I now believe the two may be specifically united.

but at Walton Naze, in the Red Crag, small specimens and fragments may be plentifully obtained.

The same proportional and other differences exist between this and the recent British shell as between *S. siliqua* and *S. gladiolus*, and on that account I imagined it to be specifically distinct when my 'Catalogue' was drawn up, and proposed for it the name of *S. ensiformis*, from its near relationship; but I now believe the Crag shell to be entitled to no more, if scarcely so much, as a distinct variety, the form and position of the muscular impression varying according to the greater elongation of the shell being nearer the extremity in the more lengthened or attenuated varieties, this elongation probably being dependent upon some peculiarity of habit or locality.

In some specimens given to me as *Solen Americanus*, the proportional length is even greater than in the recent British shell, and with a rounded termination; and none of the specimens that I have seen from America appear entitled to a specific appellation different from that of *ensis*.

S. marginatus has, in the living state, a wide geographical range, being found on the coast of Finmark (*Lorén*), and according to Von Hemprich is an inhabitant of the Red Sea; but I have never met with a fragment in any of the Crag Formations that could be justly assigned to that species.

S. (Ceratisolen) legumen is given by Mr. Smith in his 'List of Shells from the Clyde Beds.'

CULTELLUS,* *Schumacker*, 1817.

CULTELLUS. *Desmoul.* 1832.

SOLEN (sp.) *Spengler, Linn., Chemn.*

Generic Character. "Testá æquivalvis, transversim oblongá, subcomplanatá utrinque hians. Cardo in valvâ dextrâ; dentes duo cardinales subcompressi alter erectus, alter decumbens. In valvâ sinistrâ cardinales tres medius sub-bifidus, apicibus divaricatis anterior decumbens. In utraque valvâ callus marginalis."—Schum.

Type. *Solen cultellus.* Animal ?

There is, I think, full justification for considering this as entitled to generic isolation; the very peculiar form of the hinge furniture, as well as the position of the ligament (being removed to some distance from the extremity), are characters very different from those of *Solen*.

There are at present but few species known, either in a recent or fossil state, possessing the above characters. Two or three shells, with this peculiar form of hinge, have been obtained from the Older Tertiaries, but I am not acquainted with any of an anterior date.

* Etym. *Cultellus*, a little knife.

CUTELLUS TENUIS, *Philippi*. Tab. XXV, fig. 2, *a—d*.

SOLENI TENUIS. *Phil.* En. Moll. Sic., vol. i, p. 6, pl. 1, fig. 2, 1836.

— — *Id.* En. Moll. Sic., vol. ii, p. 5, 1844.

— **GENUIS.** *Nyst et West.* Nov. Rech. Coq. Foss. d'Anv., p. 3, No. 4, 1839. Misprint.?

— **TENUIS.** *Nyst.* Coq. Foss. de Belg., p. 46, pl. 1, fig. 5, 1844.

CUTELLUS CUTELLATUS. *S. Wood.* Catalogue, 1840.

— — *J. Sowerby.* Min. Conch., t. 642, figs. 5—8.

Spec. Char. “*Testá oblongo-lineari, rectá, utrinque rotundatá, tenuissimá; cardinibus lateri antico approximatis, in valvulá dextrá bidentatis, in sinistrá tridentatis.*”—*Philippi*.

Shell linearly oblong, straight, rounded at both extremities, very thin; very inequilateral; two cardinal teeth in the right valve, and three in the left.

Length, $1\frac{1}{4}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Walton Naze.

This shell is rare in my cabinet. Two specimens of the right valve, and one of the left, from Walton-on-the-Naze, are all that I have seen.

The Coralline Crag at Sutton has furnished numerous fragments sufficient to justify the belief in their identity with the Belgian fossil and the Mediterranean species, but it is not *S. pellucidus*, Penn. *M. Philippi*'s figure shows a much greater inequilaterality than our fossil, one side being four times the length of the other (probably an error of the artist). In the Crag shell the proportions are as two and a half to one.

It is somewhat broader or higher on the siphonal side, and equally rounded at both extremities. The right valve is furnished with two cardinal teeth, the anterior one is vertical and compressed, the other larger and diverging. In the left valve are three teeth, the centre one is large, and deeply cleft or bifid, one portion decumbent, almost parallel with the ligamental fulcrum. The muscular marks in my specimens are indistinct.

The shell to which this appears to bear the nearest relationship (judging alone from the drawing of the exterior), is one obtained in the Corea, figured by Messrs. Reeves and Adams (*Solen albida*), ‘Voy. of the Samarang, 1850,’ p. 84, pl. 23, fig. 15.

THRACIA, *Leach*, MS. 1819.

MYA (sp.) *Montague*, 1803.

LIGULA (sp.) *Id.* 1808.

AMPHIDESMA (sp.) *Lamk.* 1818.

ANATINA (sp.) *Id.* 1818.

IXARTIA. *Leach*, MS. 1819.

THRACIA. *Blainv.* 1825. *Rang.* 1829.

OSTEODESMA (sp.) *Blainv.* 1825.

ODONCINETUS. *Da Costa*, 1829.

CORIMYA (sp.) *Agass.* 1842.

ODONTOCINETA. *Id.*

CINETODONTA. *Herrm.* 1847.

Generic Character. Shell transversely ovate, inequivalve, often nearly equilateral; tumid or compressed, generally thin, slightly gaping; surface smooth or minutely granulated. Hinge with an internal cartilage attached to a projecting callosity. Often a small cleft in the umbo, formed by the ligament. Impressions by the adductors unequal; mantle-mark deeply sinuated.

“Animal ovate; mantle closed, except for the passage of a compressed linguiform foot; siphons rather long, separated to their bases, and furnished with fimbriated orifices, which are often inflated into a globular form.”—*Clark*.

M. Deshayes having discovered a detached ossiculum in the hinge of one or more species possessing somewhat similar external characters, presumed it to exist in all, and proposed, in consequence, a family (*Osteodesmidae*) founded upon this character, distinguishing the genera by the peculiar form of this “little bone,” and its position in the hinge, it being held between the cardinal callosities by a portion of the internal ligament, sometimes close to the anterior, at others on the opposite part of the cartilaginous area.

The distinctions founded upon such characters are but doubtfully sufficient for generic separation, even where its position could be correctly determined. There is, however, a peculiarity in the calcareous callus of the hinge, or support for the ligament, in this genus, sufficient to prevent its being confounded with any other.

The shells are generally thin, with a rugose or scabrous exterior. They are probably of great antiquity, as fossils of this form are found in the lower Oolites, and doubtfully so in the Carboniferous series.

In the living state, the species frequent sandy or sandy-mud shores, and have a range from low-water mark to very considerable depth. Dead shells have been found as deep as 110 fathoms.

1. THRACIA PUBESCENS, *Pulteney*. Tab. XXVI, fig. 1, *a—d*.

- MYA PUBESCENS. *Pult.* In Hutchins' Dorset., p. 27.
 — — *Turt.* Conch. Dict., p. 99, fig. 35, 1816.
 — DECLIVIS. *Donov.* Brit. Shells, vol. iii, pl. 82, 1801.
 ANATINA MYALIS. *Desh.* 2d ed. Lamk., vi, p. 80, 1835.
 — — *Crouch.* Int. to Lamk. Conch., p. 7, pl. 4, fig. 1, *a, b*, 1827.
 — PUBESCENS. *Turt.* Brit. Biv., p. 45, 1822.
 AMPHIDESMA PUBESCENS. *Flem.* Brit. An., p. 431, 1828.
 THRACIA PUBESCENS. *Kiener.* Coq. viv. Thracia, p. 5, pl. 2, fig. 2.
 — — *Desh.* Exp. Moree. Zool., p. 87, pl. 18, fig. 1.
 — — *Couth.* Bost. Journ. Nat. Hist., vol. ii, p. 135, 1839.
 — — *J. Sow.* Min. Conch., t. 631, fig. 1, 1844.
 — — *Forbes.* Ægean Invert., p. 182.
 — — *Forb. and Hanl.* Hist. Brit. Moll., p. 226, pl. 16, figs. 2, 3.
 — MONTAGUI. *Leach,* MSS., 1818. Ann. and Mag. Nat. Hist., vol. xx, p. 272, 1847.
 LLGULA PUBESCENS. *Mont.* Test. Brit. Supp., p. 23, 1808.

Spec. Char. *Testá ovato-oblongá, transversá, convexiusculá, tenui, subæquilaterali, anticè rotundatá, posticè truncatá, et angulatá; punctis minutissimis asperatá; callo ligamentifero magno.*

Shell ovately oblong, transverse, slightly convex, thin, subequilateral, anterior side rounded, posterior truncated and angulated, exterior minutely granulated; hinge with large projecting callus, divided by a ridge.

Length, $2\frac{1}{2}$ inches. *Height*, $2\frac{1}{2}$ inches.

Locality. Cor. Crag, Sutton and Gedgrave.

Clyde Beds. *Smith.*

Recent, Britain and Ægean.

A thin and fragile shell, not very rare, but difficult to obtain. Like most of the specimens of this genus found in the Crag, they are somewhat distorted from compression, and one or other of the valves in consequence cracked, thereby altering a little the natural appearance of the shell. On closely comparing it with the existing species, it may be remarked that the left valve is rather less contracted,—that is, the ventral margin is more convex, or not so straight, as in the living shell, and the umbo apparently less prominent; but the few specimens that I have seen are all pushed a little out of their natural position, and these trifling differences would probably disappear in a larger and better series.

2. THRACIA PHASEOLINA, *Lamarck.* Tab. XXVI, fig. 2, *a—c.*

MYA DECLIVIS. *Turt.* Conch. Dict., p. 98, 1816.

ANATINA DECLIVIS. *Id.* Brit. Biv., p. 47, 1822.

— PUBESCENS. *Id.* Brit. Biv., p. 45, t. 4, fig. 3 (young).

AMPHIDESMA PHASEOLINA. *Lamk.* Hist. Nat., tom. v, p. 492, No. 11, 1818.

THRACIA PHASEOLINA. *Keiner.* Coq. viv. Thracia, pl. 2, fig. 4.

— — *Phil.* En. Moll. Sic., vol. i, p. 19, t. 1, fig. 7, 1837.

ODONCINETA PAPYRACEA. *Da Costa.* Test. Sicil., p. 23, pl. 2, figs. 1—4, 1829.

THRACIA PHASEOLINA. *Forb. and Hanl.* Hist. of Brit. Moll., p. 221, pl. 17, figs. 5, 6; and pl. II (animal), fig. 4, 1848.

— — *Couth.* Bost. Journ. Nat. Hist., p. 147, 1839.

— — *Lovén.* Ind. Moll. Scand., p. 46, No. 321, 1846.

TELLINA PAPYRACEA. *Poli.* Test. Sicil., t. 15, fig. 18.

Spec. Char. *Testá elongato-ovatá, transversá, subæquilaterali, tumidiusculá, tenui; anticè rotundatá, posticè truncatá; margine ventrali convexiusculo.*

Shell elongato-ovate, transverse, nearly equilateral, thin, and fragile; anterior side rounded, posterior truncated; ventral margin slightly rounded.

Length, 1 inch. *Height*, $\frac{5}{8}$ inch.

Locality. Cor. Crag, Sutton.

Recent, Britain, Mediterranean, Scandinavia.

Small specimens are by no means rare at Sutton; and as the recent conchologists profess to have sufficient evidence for the separation of this from the young of *T.*

pubescens, I have followed their example, although the characters for specific separation are not clearly defined,—the distinction appearing to rest solely upon one being more transverse than the other. There is, I think, little doubt but the so-called two species lived in the sea that deposited the Coralline Crag.

Two or three fragments of what may be this species, or the young of the preceding, are in my cabinet, from the Red Crag of Sutton; and a specimen belonging to this transverse form is in the cabinet of Mr. Morris, from Uddevalla.

Thracia detruncata, of my 'Catalogue' (fig. 1, *e*), is probably only a distorted specimen of a young individual of either this or of the preceding species.

The umbo is cleft by the ligament, which must have been visible when the valves were closed.

3. THRACIA INFLATA, *J. Sowerby*. Tab. XXVI, fig. 6, *a—e*.

THRACIA CONVEXA. ? *S. Wood*. Catalogue, 1840.

— INFLATA. *J. Sow*. Min. Conch., t. 631, figs. 2—4, 1845.

— CONRADI. ? *Couth*. Bost. Journ. Nat. Hist., vol. ii, p. 153, pl. 4, fig. 2, 1839.

Spec. Char. Testá obovatá, convexa, inflatá, sublævigatá, tenui, fragili; anticè rotundatá, posticè subtruncatá et angulatá; margine ventrali arcuato.

Shell obovate, convex, tumid, nearly smooth, thin and fragile; anterior side rounded, posterior angulated and pointed; ventral margin curved.

Length, $3\frac{1}{2}$ inches. *Height*, $2\frac{3}{4}$ inches.

Locality. Cor. Crag, Sudbourn.

This species appears to be restricted to the neighbourhood of Orford, where it is not at all scarce, though the specimens are rarely in perfect condition: they are generally more or less compressed, and the inflated character destroyed. Amongst my specimens a considerable variation may be observed, some being much more elongated than others.

The right is the thinner and more inflated valve, and the one that is generally fractured and compressed. Impressions by the adductors are unequal in size, and the sinus in the mantle-mark is rounded and rather deep. A small sinus is visible at the umbones, through which the ligament must have protruded; but that part of the shell being particularly thin, it is there generally destroyed or injured. The hinge is an elongated callosity, on which was placed the cartilage, with a linear depression or furrow on the outside of it for the ligamental portion, differing from that of *T. pubescens*, in which this callus is of a triangular form and projects inwardly. The exterior is smooth, with the exception of lines of growth and some rugosities, particularly upon the siphonal side; but it has not the shagreen-like sculpture which ornaments the entire surface of *T. pubescens*.

From the want of a good series of very perfect specimens, it is difficult to say whether this be really distinct. *T. corbuloides* appears to have the anterior side the smaller; and although *T. Conradi* comes very near to our Crag fossil, it differs also in the same character, and has a rather more prominent umbo. A difference also is shown in the sinus, which is not only deeper, as it would naturally be from the difference in the proportion of the sides, but it appears somewhat more angular in the recent American shell. I am, however, inclined to believe, that when a better comparison can be instituted, it may be found not to differ specifically from *T. Conradi*.

4. *THRACIA VENTRICOSA*, *Philippi*. Tab. XXVI, fig. 5, *a—c*.

THRACIA PUBESCENS. *Phil.* En. Moll. Sic., vol. i, p. 19, t. 1, fig. 10, 1836.

— *VENTRICOSA*. *Id.* En. Moll. Sic., vol. ii, p. 17, 1844.

Spec. Char. *Testá ovato-oblongá, tumidá, subæquilaterali, inæquivalvi, tenui; anticè angustatá, posticè truncatá, et angulatá; valvá dextrá tumidiore; umbonibus magnis recurvatis; margine ventrali convexiusculo.*

Shell ovately oblong, inequilateral, tumid, inequivalved, thin; anterior side slightly produced, posterior truncate and angulated; right valve the more tumid; beaks large; ventral margin slightly curved.

Length, $1\frac{3}{4}$ inch. *Height*, $1\frac{1}{8}$ inch.

Locality. Cor. Crag, Ramsholt, Gedgrave.

Fossil, Sicily.

Two or three specimens only have come into my possession. They are assigned to the Sicilian species with a slight degree of doubt, differing somewhat from a Sicilian fossil in my cabinet, which I presume to be the *T. ventricosa*. It is rare to find the fossils belonging to this genus in a perfect condition, their extreme thinness being insufficient to preserve them in their natural form, and their characters in consequence are difficult to determine.

Our fossil is finely granulated all over, more particularly so on the siphonal side, differing from the preceding (*T. inflata*), the shells of which are nearly smooth. Philippi represents his shell as equivalved; but in my Sicilian fossil there is an evident inequality in the valves, and the proportions of the two sides do not exactly correspond.

There is a linear depression for the ligamental portion of the hinge, and the support for the cartilage is very narrow, giving it almost the appearance of having an entirely external ligament.

T. convexa is said by Messrs. Forbes and Hanley to be found fossil in the Newer Tertiaries or Pleistocene Clays of Belfast, as also in the Clyde Beds.

COCHLODESMA,* *Couthouy*, 1839.

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| SPOONHINGE. <i>Petiver</i> , 1764. | BONTEA. <i>Leach</i> , MS. 1819. <i>Gray</i> , 1851. |
| LATERNULA. <i>Bolten</i> , 1798. | GALAXURA. <i>Id.</i> 1819. |
| MYA (sp.) <i>Mont.</i> 1803. | PERIPLOMA. ? <i>Schum.</i> 1817. |
| LIGULA (sp.) <i>Id.</i> 1808. | AMPHIDESMA (sp.) <i>Flem.</i> 1828. |
| AURISCALIUM. <i>Muhl.</i> 1811. | THRACIA (sp.) <i>Lovén.</i> 1846. |
| ANATINA (sp.) <i>Lamk.</i> 1809. <i>Woodw.</i> 1854. | |

Generic Character. Shell thin, transversely ovate, slightly inequivalved, inequilateral, gaping, rather compressed, right valve the more convex. Hinge with a spoon-shaped process in each valve, for the reception of the cartilage, with a minute fissure in the umbo, through which the ligament slightly projects. Surface smooth, or finely granulated, especially on the siphonal side; covered in the recent state with a fine epidermis. Adductor muscles slightly impressed, with a sinus in the impression of the mantle.

Animal with its mantle closed, except in front, for the emission of a broad compressed foot; siphons long and slender, divided in their whole extent.

This genus closely resembles that of *Thracia*, in the animal as well as in the shell, differing in the latter, however, by having the support for the cartilage of a more spatulate or spoon-shaped form, which is less intimately united along the dorsal edge, and in the absence from the hinge of the ossiculum.

The name *Anatina* was proposed as a genus by Lamarck in 1809, taking for his type *Solen anatinus*, Linn., a shell in some respects similar to those here included, by having a spoon-shaped process projecting inwardly, upon which was placed its internal ligament. It has, however, a very wide gape, and the animal has long and *united* siphons, clothed with a wrinkled epidermis; while the animal of *Cochloodesma* has its siphons long, slender, and *divided* throughout. The animals, therefore, being so dissimilar, they are scarcely entitled to the same name, nor could they be included in the above generic diagnosis.

I have never seen a shell with this form of hinge from any Formation of an age anterior to that of the Coralline Crag.

1. COCHLODESMA COMPLANATUM, *S. Wood.* Tab. XXVI, fig. 3, *a, b.*

Spec. Char. Testá compressá, elongato-subovatá, lævi, inæquilaterali, tenui; anticè majiore, rotundatá; posticè subtruncatá; valvâ sinistrâ depressá; sinu palliari mediocre.

Shell compressed, elongately ovate, smooth and very thin, inequilateral: anterior

* Etym. κοχλος, shell, and δεσμα, ligament.

side the larger, and rounded; left valve much depressed; pallal sinus of moderate size, rather broad.

Length, $\frac{7}{8}$ inch. *Height*, $\frac{9}{16}$ inch.

Locality. Red Crag, Walton Naze.

About half a dozen perfect specimens are in my cabinet: unfortunately they are all the left valve.

In comparing my fossils with a specimen of *Cochlodesma Leanum*, Couthouy, 'Bost. Journ. Nat. Hist.,' vol. ii, p. 170, (a recent species from America, and its nearest relative,) the Crag shell appears to be less equilateral, the siphonal side being much the shorter of the two, and I have in consequence considered it distinct. Our shell may be further described as rather flatter compressed, the left valve being the more so of the two, judging from a fragment of the right one in my cabinet; the umbones are slightly prominent, and cleft by the ligament; the spoon-shaped process is broad and strong, projecting towards the anterior; the exterior shows merely lines of growth, with a slight rugosity on one side, but it is not covered with the granulated or shagreen surface of *C. prætenue*; the pallal sinus extends inwardly, a little beyond a line drawn perpendicularly from the umbo.

2. COCHLODESMA PRÆTENERUM, S. Wood. Tab. XXVI, fig. 4, a, b.

ANATINA PRÆTENERA. S. Wood. Catalogue, 1840.

Spec. Char. Testá transversá, ovatá, inæquilaterali, inæquivalvi, tenui, fragili; anticè rotundatá convexiusculá; posticè brevior, truncatá, subrostratá; tenuissimè granulatá.

Shell transversely ovate, inequilateral, inequivalved, thin and fragile, with a finely granulated exterior; anterior side the larger, rounded, and slightly tumid; ventral margin curved.

Length, $\frac{3}{4}$ inch. *Height*, $\frac{1}{2}$ inch.

Locality. Cor. Crag, Sutton.

I have about half a dozen specimens of this shell. It differs from *C. prætenue* in having the siphonal side shorter, narrower, and truncated, with a more distinct angular slope from the umbo to the ventral margin; the anterior dorsal edge is very thin, and slightly folded over, with a small sinus at the extreme point of the umbo, through which the ligament was visible, and probably projected somewhat; the exterior is smooth to the naked eye, but under a magnifier appears finely granulated. The impressions by the adductor muscles indistinct; the pallal sinus extends a little beyond the cartilage support.

A small specimen in my cabinet, from the same locality, strongly resembles, and is probably the young state of *C. prætenue*, but the hinge is injured. I have some fragments also of what may perhaps be another species, with a very scabrous

surface, which passed in my 'Catalogue' under the name of *A. asperima*; they are too imperfect for further notice. The siphonal side appears too short to belong to *C. prætenue*, and too rugose for the present species.

PHOLADOMYA, *G. Sowerby*, 1823.

CARDIUM (sp.) *Mantell. J. Sowerby.*

LUTRARIA (sp.) *J. Sowerby.*

CARDITA (sp.) *J. Sowerby.*

Generic Character. Shell very thin, transparent or hyaline, of a nacreous texture, transverse, ovate or cordiform, ventricose, equivalved, inequilateral; anterior side short, posterior produced and gaping. Hinge with a small obtuse tooth. Ligament external. Mantle-mark deeply sinuated.

Animal of the form of the shell, with the edges of the mantle united, except where open for the emission of the foot, which is bifurcated. Siphonal tubes large.

Only one species of this genus is known in the living state, and that is an inhabitant of the tropics and was found at St. Lucia.* The animal of this has been examined by Professor Owen, whose observations thereon were made known at the Zoological Society in 1842.

Its position, as indicated by the animal, is considered by that anatomist to be near to *Panopæa*. Dr. Gray, in his arrangement, has placed it between *Cardita* and *Astarte*.

It is, no doubt, very nearly related to a group of shells largely developed in the Secondary Formations, for which M. Agassiz proposed to establish a family under the name *Myadæ*, 'Etudes Critiques sur les Mollusques fossiles.' These he separated into several genera, the divisions depending sometimes upon the hinge furniture, but in most instances upon the outward form of the shell, a dependence by no means safe.† These fossils are generally found in a state of casts only, though some few of them have been obtained exhibiting portions of the shell attached, showing them to have possessed a thin, oftentimes a papyraceous and transparent shell, of a nacreous texture, and they were in most instances covered with a papillaceous or scabrous exterior. They bear a considerable inter-resemblance in their general character, and are no doubt intimately connected zoologically; but they are of very doubtful relationship to *Mya*, the reputed father of the family, whose age we are unable to date beyond the Tertiaries.

* *Ph. crispa* and *Ph. caspica*, given by Agassiz in his 'Monog. of the Myadæ' as existing species, belong to, or at least are nearly related to, the genus *Cardium*, and differ only in having elongated siphons, and a sinuated mantle-mark (*Adacna*, Eichwald). *Lyonsia navicula*, Reeves, 'Voy. of the Samarang,' p. 38, pl. 23, fig. 11, may perhaps be an aberrant form of this genus.

† This family has been ably analysed by Professor Morris in his recent 'Descriptions of the Fossils of the Great Oolite.'

Pholadomya is a genus of great geological antiquity, being known as early as the Coal Measures, and continued to the present time through the Secondary Periods, where it was largely developed, presenting only a few species in the Tertiaries.

PHOLADOMYA HESTERNA, *J. Sowerby*. Tab. XXX, fig. 1, *a—d*.

PHOLADOMYA CANDIDOIDES. *S. Wood*. Catalogue, 1840.

— HESTERNA. *J. Sow*. Min. Conch., t. 629, 1844.

Spec. Char. *Testá transversá, ovato-oblongá, aut irregulariter pyriformi, valdè inæquilaterali; anticè ventricosá, rotundatá vel subtruncatá; posticè productá; medianá parte costatá, costis 10—12.*

Shell transverse, ovately oblong or of an irregular pear-shape, very inequilateral; anterior side ventricose, rounded, or slightly truncated; posterior much produced; centre covered with about 10 or 12 ribs.

Length, 4 inches. *Height*, $2\frac{1}{2}$ inches.

Locality. Cor. Crag, Ramsholt and Sudbourn.

This species, as might be expected, is found only in beds which have undergone no disturbance; and at Ramsholt, where these shells are quietly deposited in the sand, I have seen many specimens, but they are exceedingly difficult to obtain, and then with only a small portion of its thin shell remaining. Like those from some parts of the London Clay, the specimens are in general much distorted. Our figure is from one that has preserved its natural form; and although there is a considerable resemblance to the only living species that has as yet been discovered, it seems to be specifically distinct. The recent shell, *Ph. candida*, is more tumid centrally, and less rounded on the anterior side, while on the other it is not so broad, and there is a greater curve in the ventral margin. Our shell appears to have been closed on the anterior side, but had a gape or opening for its probably lengthened siphonal tubes. The hinge is furnished with a small obtuse tooth in each valve, and a marginal lamina or fulcrum for the ligament, this is bipartite, separating slightly the cartilage from the ligament; the umbones, like those of the recent shell, approximate so closely as to have been fractured by the opening of the valves. The ribs of our shell extend over rather more than half the surface, from the obtuse ridge on the anterior side to within about the same distance from the other extremity, and they are covered with small obtuse tubercles; while the small portions of the shell that are remaining present a finely granulated surface, or shagreen, like those of *Anatina*. This is especially visible near the siphonal extremity, but was probably more or less granular all over. *Ph. arcuata*, Agass., 'Etud. crit.', p. 63, t. 2, *b*, figs. 1—8, resembles our shell, judging from the figure, but appears to have had too many ribs. *Ph. Esmarkei* (Pusch), Goldf., 'Petr. Germ.', vol. ii, p. 272, t. 157, fig. 10, *a—d*, may probably be the same. I have been unable to examine specimens of either, and have therefore retained Mr. Sowerby's name.

POROMYA, Forbes, 1843.

CORBULA (sp.) Nyst and West., 1839.

EMBLA. Lovén, 1846.

Generic Character. "Shell ovate or suborbicular, equivalve, inequilateral, slightly produced posteriorly; surface invested with a scabrous epidermis, beneath which it is pearly and minutely punctated; hinge of a minute cardinal ossicle or erect tooth in one valve, lodged in a pit, or rather depression in the other; no lateral teeth; ligament *external*; palleal impression very slightly sinuated.

"Animal with its mantle open in front; foot long, narrow, and slender; siphons short, unequal, with 18 or 20 tentacles surrounding their bases."—Forb. and Hanl.

"*Testâ æquivalvis, posticè hians, truncatâ; ligamentum internum foveæ utriusque valvæ insertum, ante quam in v. d. dens cardinalis, in v. s. fossâ cardinalis; in v. s. dens lateralis anticus et posticus; in v. d. fossa lateralis, dentes laterales nulli. Impressio palliaris lata, duplicata, posticè leviter sinuosa.*

"*Animal pallio ventre aperto, posticè longe cirrigero, siphonibus instructum.*"—Lovén.
Genus, *Embla*.

Mr. Woodward, in his 'Rudimentary Treatise of Recent and Fossil Shells,' has concluded the *Poromya* of Forbes to be a species only of the genus *Thetis*.

The establishment of a genus by the above-named eminent and able modern authors upon an existing shell, the one describing it as possessing an *external* ligament, while the other considers it to have an *internal* one, leaves it, as it were, a sort of open question, or placing it rather in a doubtful position. The type of the genus *Thetis* has an *external* ligament, whereas in the recent British shell and Crag fossil the hinge furniture is more complex; and although a portion of the ligament might have been seen externally when the valves were closed, the larger or cartilaginous part was situated within the edge of the shell, and its action like that of an internal ligament, opening the valves by expansion on the removal of pressure; no portion of which internal ligament appears to be present in those fossils constituting the genus *Thetis*; and as I am imposing no new name for the Crag shell, the correct position must be determined by better materials than I possess; though, judging from my own specimens, I am inclined to believe with Professor Lovén, that the action of its ligament was that of an internal one; and although the greensand fossils are no doubt closely related, the difference in position or action of the ligament is sufficient to justify the separation.*

* The boundary line of generic isolation is indeed exceedingly difficult to define. We all of us give what we conceive to be a limit, but the want of accordance in this respect shows at least that we are as yet very far from having discovered it. The different positions of the ligament in Bivalves, whether acting internally by compression and dilatation, or externally by contraction and elongation over a fulcrum, are distinctions as good as nine out of ten of the characters that are generally employed for these conventional divisions.

The recent species *Neæra hyalina*, Hinds, appears to be more nearly connected with *Thetis*, having an external ligament on a thin and semi-transparent shell, differing thereby from our fossil, which is a thick one. The two shells figured by Messrs. Reeves and Adams in the 'Zoology of the Voyage of the Samarang,' may perhaps belong to *Thetis*, but the position of the ligament is not stated, and the shells are described as being quite smooth and thin.

The Cretaceous fossils of India and Westphalia, assigned to this genus, have not as yet had their characters sufficiently well determined.

1. POROMYA GRANULATA, *Nyst* and *Westendorp*. Tab. XXX, fig. 5, *a—f*.

CORBULA GRANULATA. *Nyst* and *West*. *Nouv. Rech. Coq. Foss. d'Anv.*, p. 6, No. 10, pl. 3, fig. 3, 1839.

— ? — *Nyst*. *Coq. Foss. de Belg.*, p. 71, pl. 2, fig. 6, 1844.

— ? — *Jeffreys*. *An. and Mag. Nat. Hist.*, vol. xix, p. 314; and vol. xx, p. 19.

POROMYA ANATINOIDES. *Forbes*. *Ægean. Invert. Brit. Assoc. Report*, p. 191, 1843.

— GRANULATA. *Forb. and Hanl.* *Hist. of Brit. Moll.*, p. 204, pl. 9, figs. 4—6, 1848; and *Animal*, pl. w, fig. 2, 1853.

EMBLA KORENII. *Lovén*. *Ind. Moll. Scand.*, p. 46, 1846.

Spec. Char. *Testá ovatá, ventricosá, subæquilaterali; anticè rotundatá, posticè truncatá, et obtusè angulatá; aculeis minutissimiss criberrimis aspera; umbonibus prominentibus; dente unico obtuso.*

Shell ovate, ventricose, slightly inequilateral; anterior side rounded, posterior truncated, with an obtuse keel or ridge retreating from the umbo to the ventral margin; beaks prominent; one obtuse tooth.

Length, $\frac{1}{2}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Ramsholt, Sutton, and Gedgrave.

Recent, Ægean, British, and Scandinavian Seas.

About a dozen disconnected valves have been obtained by myself, several of them sufficiently perfect for fair comparison, and I have considered them as identical with the Belgian fossil and the Ægean and Scandinavian shell.

The hinge of the right valve is furnished with one large obtuse tooth, situated immediately beneath the umbo, and in the left there is a corresponding cavity between two small prominences for its reception; behind these, and within the dorsal margin, is a depression wherein, I presume, the ligament was placed: this cavity is divided by a small ridge, which appears to have separated the cartilage from the ligament, and the latter probably was visible externally when the valves were closed: there is a small depression on the siphonal side at the dorsal edge, what may perhaps be called the corslet, produced probably by the opening of the valves; but there is no ridge or fulcrum for the support of an *external* ligament. The impressions by the

adductors are rather small and deep, and the mantle-mark has an irregular sinus, by no means large. The shell is beautifully nacreous within, and the exterior is ornamented with papillæ or granulations, studded somewhat like the barrel of a musical box.

In the living state this species has been met with in deep water, while some of its associates in the Coralline Crag are very shallow-water forms. Mr. Jeffreys has dredged it off the Isle of Skye in 50, and Professor E. Forbes obtained it in the Ægean at the depth of 150 fathoms.

At page 148 (*ante*), I had supposed the genus *Thetis* to have been nearly related to *Lucinopsis*, but this allocation is probably incorrect. In Mr. Woodward's 'Rudimentary Treatise of Recent and Fossil Shells,' it is arranged in his family *Myacidæ*. I think, however, the present species, *Poromya granulata*, cannot be correctly placed, as it is there, between the genera *Mya* and *Panopea*.

Corbula gigantea, J. Sowerby, *Thetis gigantea*, Woodward, has a granulated exterior, with an external ligament, and faint or obsolete costæ; and if it be not a true *Pholadomya*, it forms a connecting link between that genus and *Thetis*.

PANDORA,* *Brug.* 1792.

HYPOGÆA and HYPOGEODERMA (sp.) *Poli.*
TELLINA (sp.) *Linn.*
SOLENI (sp.) *Mont.*

CALOPODIUM. *Bolten*, 1798.
TRUTINA. *Brown*, 1827.

Generic Character. Shell transverse, inequivalve, inequilateral, ovate or subrhomboidal, externally smooth and of a nacreous texture, gaping at the anterior extremity, one valve flat, the other more or less convex. Hinge with a prominent obtuse tooth upon the right or flatter valve, and a corresponding depression for its reception in the opposite one. Impressions of the adductor muscles subcircular, with a small or scarcely perceptible sinus in that by the mantle. Ligament internal.

The mantle is described as nearly closed, with a small passage for a narrow tongue-shaped foot; and the siphons are represented as very short, united nearly to their orifices, which are fringed, and diverging.

The inequality of the valves and internal ligament have been considered as characters sufficient to approximate this genus to that of *Corbula*, from which, however, it is sufficiently removed, as essential differences exist in the animal inhabitant, but more especially in the composition of its shell. In the examination and report by Dr.

* Etym. *Pandora*, a proper name. This was given also to the inequivalved *Pectens*, probably from their box-like character.

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* Etym. *Pandora*, a proper name. This was given also to the inequivalved *Pectens*, probably from their box-like character.

Carpenter, that gentleman seems to think it so peculiar, as almost to constitute a family by itself. He describes the exterior as composed of regular prismatic cells, the axes of the prisms being perpendicular to the surface, while the interior is nacreous.

No well-determined species have been met with in the fossil state in any Formation older than the Paris Basin. A shell from the Carboniferous Series is described by Professor M'Coy under this name; but its claim to a place in this genus is very doubtful.

1. PANDORA INÆQUIVALVIS, *Linn.* Tab. XXV, fig. 5.

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| TELLINA INÆQUIVALVIS. | <i>Linn.</i> | Syst. Nat., ed. 12, p. 1118, No. 56, 1767. |
| — | — | <i>Poli.</i> Test. utri. Sicil., vol. i, p. 39, pl. 15, figs. 5, 6, 9, and 7 with the animal. |
| — | — | <i>Don.</i> Brit. Shells, vol. ii, pl. 41, fig. 1, 1800. |
| PANDORA ROSTRATA. | <i>Desh.</i> | 2d ed. Lamarck, tom. vi, p. 145. |
| — | — | <i>G. B. Sowerby.</i> Spec. Conch. Pandora, p. 2, No. 2, figs. 7—9. |
| — | — | <i>Phil.</i> En. Moll. Sic., vol. i, pl. 1, fig. 12, 1836. |
| — | — | <i>Desh.</i> Exp. Scient. Algér. Moll., pl. 24, animal. |
| — | — | <i>Forb. and Hanl.</i> Hist. Brit. Moll., vol. i, p. 207, pl. 8, figs. 1—4. |
| — | MARGARITACEA. | <i>Lamk.</i> Hist. des An. s. Vert., tom. v, p. 137. |
| — | — | <i>Schum.</i> Essai des Vers. Test., p. 114, pl. 4, fig. 2. |
| — | — | <i>Turt.</i> Brit. Biv., p. 40, pl. 3, figs. 11—14, 1822. |
| — | INÆQUIVALVIS. | <i>Flem.</i> Brit. Anim., p. 466, 1828. |

Spec. Char. Testá elongato-ovatá, lævigatá, tenui fragili, inæquilaterali; latere postico longiore, attenuato subrostrato, hinc in utraque valvâ angulato.

Shell elongately ovate, smooth, thin and fragile, inequilateral; posterior side the longer, attenuated, and somewhat beaked, slightly angulated in each valve.

Length, $\frac{5}{8}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

Recent, Britain and Mediterranean.

My specimens of this species are but few, and those not in good condition. The one figured has the siphonal area elongated into the form of a rostrum or beak, and corresponds with what the British conchologists have considered a distinct species. In the young state, as indicated by the lines of growth, the dorsal margin is more convex than concave, and the shell comparatively broader, like *P. Pinna*, and there is no appearance then of a rostrum.

2. PANDORA PINNA, *Montague.* Tab. XXV, fig. 4, a—c.

SOLENN PINNA. *Mont.* Test. Brit., p. 566, t. 15, fig. 3, 1803.

PANDORA OBTUSA. *Leach.* Ross's Voy. Baffin's Bay, p. 174, 1819.

- PANDORA OBTUSA. *Desh.* 2d ed. Lamarck, tom. vi, p. 145, No. 2.
 — — *G. B. Sowerby.* Spec. Conch. (Pand.), p. 2, figs. 1—3.
 — — *Phil.* En. Moll. Sic., vol. ii, p. 14, t. 13, fig. 13.
 — — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 210, pl. 8, fig. 5; and
 pl. 6, fig. 10, animal.
 TRUTINA SOLENOIDEA. *Brown.* Illust. Brit. Conch., pl. 13, fig. 5, 1827.

Spec. Char. *Testá obtusè-elongatá; latere postico versus extremitatem dilatato; margine dorsali planiusculo.*

Shell obtusely elongate; posterior side dilated towards the extremity; dorsal margin nearly straight.

Length, $\frac{5}{8}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Red Crag, Walton Naze.

Only two or three specimens of this species have fallen under my observation, and I have, in deference to the malacologists, separated this from what is called *rostrata*. Colonel Montague, who, notwithstanding his having described the two shells under different generic names, was afterwards of opinion that the one was only the younger state of the other. Messrs. Forbes and Hanley consider the characters of the animal, as well as those of the shell, to be quite distinct, and have kept the two forms separate. My own specimens are not sufficiently numerous or perfect to assist in the determination. The two shells are so much alike in the young state as to be with difficulty determinable; and I am inclined to believe with Montague, so far at least in their specific identity, that if the one be not exactly the young state of the other, there is not more than a local variation between the two. Both appear to have existed during the Crag Periods, the *rostrata* in the Cor. Crag corresponding with the more Southern form, while that from the Red Crag resembles the Northern one (probably *P. glacialis*, Leach, 'An. Phil.,' vol. xiv, p. 203, 1819).

NEÆRA,* *J. E. Gray*, 1830.

ANATINA (sp.) *Lamk.*

CORBULA (sp.) *Desh.* 1835.

THRACIA (sp.) *Brown*, 1827.

ERYCINA (sp.) *Risso*, 1826.

CUSPIDARIA. *Nardo*, 1840.

Generic Character. "Shell transversely ovato-pyriform, inequivalve, inequilateral, more or less beaked, and gaping posteriorly; surface smooth or striated, or ribbed longitudinally, never punctated, with or without an epidermis; valves strengthened internally with a longitudinal rib; hinge composed of a cartilage fulcrum, usually oblique, and spatulate in each valve, sometimes with a minute tooth beside it, and a more or less developed lateral tooth on the rostral side of one or both valves; ligament external (?), small; muscular impressions large, pallial with a very shallow sinus.

* Etym. (?) *Neæpa*, proper name. This is also employed for a genus of insects.

"Animal oblong, mantle closed in front, except a plain-edged orifice for the passage of a lanceolate foot; siphons short, united, unequal, the branchial largest, both bearing a few long filiform cirrhi at their sides, extending beyond the orifices; anal siphon with a very extensile membranous valve."—*Forbes and Hanley*.

1. *NEERA JUGOSA*, *S. Wood*. Tab. XXX, fig. 7, *a, b*.

CORBULA ? SULCATA. *S. Wood*. Catalogue, 1840.

Spec. Char. *Testá parvá, transversá, inæquilaterali, æquivalvi? compressá, jugosá; anticè rotundatá; posticè subrostratá, et angulatá; cardine unidentato.*

Shell small, transverse, inequilateral, equivalved? compressed, ridged; anterior side rounded; posterior somewhat beaked, and angulated; hinge with one tooth.

Length, $\frac{1}{8}$ inch. *Height*, $\frac{1}{12}$ inch.

Locality. Cor. Crag, Sutton.

This shell is not rare in the Coralline Crag, but as yet I have met with it only in one locality, and never with the valves united.

It much resembles the figure of one of the species from the Paris Basin, *Corbula striarella*, Desh., Coq. Foss. des Env. de Par., tom. i, p. 54, pl. 8, figs. 12—15, but differs in being less than half the size, as well as in other characters; and I believe it to be distinct, depending as I am obliged to do upon the figure and description above referred to.

In our species the hinge of the right valve has one obtuse and somewhat oblique tooth on the anterior side of the umbo, with a depression between it and the dorsal edge, into which fits an elevated portion of the margin of the left valve, while on the siphonal side of this (left valve) is an elongated and elevated projection that interlocks within the dorsal edge of the right valve; between these, and immediately beneath the umbo, is an oblique pit, where the ligament was situated, and *entirely within the shell*; so much so that I doubt whether any part of it could have been seen in the living animal when the valves were closed. The dorsal margin slopes at an angle of about 45° , and a truncated beak is formed by the siphons; the upper part being somewhat elevated producing an obtuse keel from the umbo upon the slope on that side. The exterior has from eight to ten rounded ridges, with depressions or sulci between them of about the same breadth; but upon the younger part of the shells these markings are obsolete, being smooth, or nearly so, about the umbo. The shell is by no means thin, though the ridges are generally visible upon the interior. The adductor-mark on the siphonal side is of a triangular form, and deeply impressed, placed rather backward; and the sinus in the mantle-mark moderately deep.

The provisional name given to it in my 'Catalogue' is obliged to be changed, in consequence of its having been used by Dr. Lovén for a very different species.

2. *NEÆRA CUSPIDATA*, *Oliv.* Tab. XXX, fig. 6.

- TELLINA CUSPIDATA.* *Oliv.* Zool. Adriat., p. 101, pl. 4, fig. 3, A—C, 1792.
 — — *Broc.* Conch. Foss. Subap., p. 515.
ANATINA BREVIROSTRIS. *Brown.* Ed. Journ. Nat. and Geo. Sci., vol. i, p. 11, pl. 1, figs. 1—4, 1829.
THRACIA BREVIROSTRA. *Brown.* Ill. Conch. Gr. Br., pl. 44, figs. 11—14, 1845.
NEÆRA BREVIROSTRIS. *Lovén.* Ind. Moll. Scand., p. 48, 1846.
 — *CUSPIDATA.* *Forb. and Hanl.* Hist. of Brit. Moll., p. 195, pl. 7, figs. 4—6; and pl. 6 (animal), figs. 4—7, 1848.
 — — *Forbes.* Ægean Inv., p. 185.
CORBULA CUSPIDATA. *Phil.* En. Moll. Sic., vol. i, p. 17, t. 1, fig. 19; and vol. ii, p. 12.
 — *SUBROSTRATA.* *S. Wood.* Catalogue, 1840.

A fragment only of a shell, which I consider to belong to this species, was found by myself in the Coralline Crag at Sutton, but it is insufficient for correct description: the peculiar form of the siphonal side (the portion I possess) is so characteristic that it is introduced here without much hesitation. It appears to have belonged to the British or short beaked variety.

CORBULA. Bruguière, 1792.*

| | |
|--|--|
| <i>MYA</i> (sp.) <i>Linn. Mont.</i> | <i>LENTIDIUM, Cristof. and Jans.</i> 1832. |
| <i>CARDIUM</i> (sp.) <i>Walker and Boys.</i> | <i>POTOMOMYA, J. Sowerby,</i> 1835. |
| <i>TELLINA</i> (sp.) <i>Oliv.</i> | <i>AZARA, D'Orb.</i> 1839. |
| <i>ALOÏDES, Megerle,</i> 1811. | <i>CORBULOMYA, Nyst,</i> 1843. |

Generic Character. Shell suborbicular or ovate, inequivalve, inequilateral, tumid, closed; beaks prominent, recurved surface smooth or striated; in the recent state covered with an epidermis. Hinge composed of one thick, conical tooth in each valve. Ligament internal. Impression by the mantle with a small sinus.

Animal short; mantle open in front for the emission of a thick foot, of considerable magnitude; siphonal tubes short and united to their orifices, which are fimbriated: anal opening with a conspicuous tubular membrane.

Animals constituting this genus are for the most part inhabitants of salt water, but some are estuary species, and extend their range in the river to where the water is quite fresh. A separation has been proposed, under the name *Potomomya*, for those species which permanently inhabit fresh water, but the characters of shell and animal differ in no other respect from those which are truly marine. In this genus, as well as in that of *Pandora*, the two valves are very unequal in size, but this inequality is not confined to the siphonal side of the shell, and the sinus of the mantle-mark does not

*Etym.? *Corbula*, a little basket.

vary in form or magnitude like those so conspicuously shown in some of the *Tellens*.

The species are not very numerous, even when admitting those which constantly inhabit fresh water. They are found sometimes in mud, but more frequently on sandy bottoms, and have a considerable vertical range. Fossil species have been found as early as the Lower Oolite.

1. CORBULA STRIATA, *Walker and Boys*. Tab. XXX, fig. 3, *a—d*.

CARDIUM STRIATUM APICIBUS REFLEXIS. *Walk. and Boys*. Test. Min. Rar., p. 24, t. 3, fig. 85, 1787.

TELLINA GIBBA. *Olivi*. Zool. Adriat., p. 101, 1792.

— — *Broc*. Conch. Foss. Subap., p. 517, No. 15, 1814.

MYA INÆQUIVALVIS. *Mont*. Test. Brit., p. 38, t. 26, fig. 7, 1803.

CORBULA GIBBA. *Nyst*. Coq. Foss. de Belg., p. 65, pl. 3, fig. 3, 1844.

— — *Lovén*. Ind. Moll. Scand., p. 49, 1846.

— NUCLEUS. *Lamk*. Hist. des An. s. Vert., v, p. 496, 1818.

— — *Forbes*. Report on Ægean Invert., p. 180, 1843.

— — *Phil*. En. Moll. Sic., vol. ii, p. 12, 1844.

— — *Bronn*. Leth. Geogn., p. 967, t. 37, fig. 7, *a—c*, 1838.

— STRIATA. *Flem*. Brit. An., p. 425, 1828.

— — *Desh*. Exped. Scient. Alger., p. 231.

— ROTUNDATA. *J. Sow*. Min. Conch., t. 572, fig. 4, 1827.

— — *Goldf*. Petr. Germ., vol. ii, p. 252, pl. 152, fig. 3, *a—e*, 1842.

— OLIMPLICATA. *Costa*. Cat. Syst. e. reg. Test delle 2 Sicil., p. 27, 1829.

— INÆQUIVALVIS. *Macgill*. Moll. Aberd., p. 303, 1843.

— ELEGANS. *Nyst*. Rech. Coq. Foss. Prov. d'Anv., p. 3, 1835.

— BICOSTATA. *Id*. Rech. Coq. Foss. Prov. d'Anv., No. 10, pl. 1, fig. 10.

— PLANULATA. *Id*. Coq. Foss. de Belg., p. 68, pl. 2, fig. 4, 1844.

Not CORBULA STRIATA. *Lamk*.

Spec. Char. Testá subtriangulari, gibbosá, subinæquilaterali, valdè inæquivalvi, valvá dextrá tumidiori, concentricè striatá; valvá sinistrá complanatá, sublævigatá; anticè rotundatá, posticè truncatá.

Shell subtriangular, gibbous, slightly inæquilateral, greatly inequivalve, right valve the more inflated, and roughly striated; left valve nearly flat and smooth; anterior side rounded, posterior truncated.

Diameter, $\frac{1}{2}$ inch.

Locality. Coralline Crag, Sutton, Gedgrave, Ramsholt.

Red Crag, Sutton, Bawdsey, Walton Naze.

Recent, Scandinavia, Britain, and Mediterranean.

In the Coralline Crag at Sutton this is one of the most common shells, and although furnished with an apparatus for the firm interlocking of the valves, the two

pieces are not often found in their natural position. In the Red Crag even the separated valves are by no means abundant.

Cardium striatum, of Walker and Boys, is evidently the same as our shell, and Dr. Fleming adopted that name as most entitled to priority: I followed his example in my Catalogue, and see no reason why it should now be changed. In the fossil state, this species is liable to great alteration: the outer coating which forms a perfect shell of itself, with its thick transverse ridges, comes off, leaving the inner portion perfectly smooth. *Corbula planulata*, in Sir Charles Lyell's Cabinet, received from Belgium, with that name, is, I believe, only this species in its exfoliated or decorticated condition.

Sir Charles Lyell, in his paper upon the 'Miocene Deposits of America,' has considered *Corbula elevata*, of Conrad, the same as this species, and judging from the figure by that author, he is probably correct in that assignment.

A single valve, of which I have given a representation (fig. 4), may probably be *C. rosea*, but in such a genus as this, in which the species are by no means easily defined, I prefer leaving it without description for the present.

2. CORBULA COMPLANATA, *J. Sowerby*. Tab. XXX, fig. 2, *a—d*.

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|------------------------|----------------|---|
| CORBULA COMPLANATA. | <i>J. Sow.</i> | Min. Conch., t. 362, figs. 7, 8, 1822. |
| — | — | <i>Desh.</i> Coq. Foss. des Env. de Par., pl. 7, figs. 8, 9, 1824. |
| — | — | <i>Dujard.</i> Mem. de la Soc. de France, tom. ii, pt. 2, p. 256, 1837. |
| — | — | <i>Desh.</i> 2d ed. <i>Lamk.</i> tom. vi, p. 142, 1835. |
| — | — | <i>Grat.</i> Cat. Zool. des An. du Basin Tert. de la Gironde, p. 67, No. 794, fig. 3, 1838. |
| — | — | <i>Bronn.</i> Leth. Geogr., p. 969, t. 37, fig. 8, <i>a, b</i> , 1838. |
| — | DONACIFORMIS. | <i>Nyst.</i> Rech. Coq. Foss. de Hoesselt et Kl. Spawen, p. 3, No. 6, pl. 1, fig. 6, 1836. |
| CORBULOMYA COMPLANATA. | <i>Nyst.</i> | Coq. Foss. de Belg., p. 59, pl. 2, fig. 2, 1844. |
| ERYCINA TRIGONA. | <i>Lamk.</i> | Ann. du Mus., tom. vi, p. 413, No. 3. |

Spec. Char. *Testá transversá, ovatá, vel donaciformi inæquilaterali, compressá aut complanatá, lævigatá, crassá; anticè majore rotundatá; posticè angulatá, truncatá, et sub-carinatá; dente cardinali unico in valvâ dextrâ.*

Shell transverse, ovate, or wedge-shaped, inequilateral, compressed or flattened, smooth, and thick; anterior side the larger and rounded; posterior angulated, truncated, and slightly keeled; one cardinal tooth in the right valve.

Length, $1\frac{1}{4}$ inch. *Height*, $\frac{3}{4}$ inch.

Locality. Red Crag, Sutton and Walton Naze.

Fossil in the Paris basin, and at Kleyn Spauwen, the Basin of the Gironde, and in the Faluns of Touraine.

This is a rare shell, though solid and strong, and does not appear to have been an inhabitant of the Coralline Crag sea, though a species supposed to have been trans-

mitted from the Older Tertiaries. M. Deshayes says the Paris Basin shell is undoubtedly identical with the Touraine species; the latter corresponds more closely with the Crag fossil; the Kleyn Spauwen shell resembles more (as might be supposed) the Paris Basin variety. The Touraine specimens differ slightly from the Crag fossil, but not, I think, sufficiently to invalidate their identity. In our shell the siphonal side is not so pointed or keeled, and there is a little difference in the dental furniture, and the palleal sinus is a trifle larger.

The ligament is placed in a fossette in the right valve, visible externally, when the valves are closed, through a sinus in the umbo; the left valve has a projection on which are placed both ligament and cartilage, separated by a ridge: before this ligament is a tooth in each valve. This was probably an estuary shell. The locality (Roydon), given for it in 'Min. Conch.,' is an error.

SPHENIA BINGHAMI? *Turton*. Tab. XXIX, fig. 7.

SPHENIA BINGHAMI. *Turt.* Brit. Biv., p. 36, t. 3, figs. 4, 5; and t. 19, fig. 3, 1822.

SPHENIA BINGHAMI. *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 190, pl. 9, figs. 1—3, 1848.

CORBULA BINGHAMI. *Hanley.* Recent Shells, p. 47; Supp., pl. 12, fig. 4.

— — — *Woodw.* Man. of Moll., vol. ii, p. 318.

Spec. Char. *Testá minutá, transversá, cuneiformi tenui fragili, lævigatá, valdè inæquilaterali; anticè rotundatá, posticè angustá, subrostratá.*

Shell small, transverse, wedge-shaped, thin and fragile, smooth, and very inequilateral; anterior side rounded; posterior produced and somewhat pointed.

Length, $\frac{1}{4}$ inch.

Locality. Cor. Crag, Sutton.

Recent, Britain?

The genus *Sphenia* has been founded upon a single species of Mollusc inhabiting our own shores, and is at present not well established: the animal has been examined by Mr. Clark who says it is quite distinct from *Mya* or *Saxicava*, though not far removed from either; perhaps still nearer to *Corbula*.

Only two or three specimens, and those not in very good condition, are in my Cabinet; they will not throw any light upon the obscurity which hangs over the recent shell.

My best specimen has a spatulate tooth in the left valve, like that in the young of *Mya*, which it resembles in some characters, but it is much thinner, with something of a nacreous appearance; and the outline also is different from that of the young of *Mya* of the same size: mine is, however, a very doubtful identity of the existing species.

MYA.* *Linnæus*, 1747.

MYA, *Lamk.* 1801.

SPHENIA (sp.) *Turt.* 1822.

Generic Character. Shell transverse, equivalve, subequilateral, more or less of an ovate or oblong form, gaping at the siphonal extremity; externally striated or furrowed by rough or irregular lines of growth; in the recent state covered by an epidermis. Hinge composed of a large, projecting, spoon-shaped tooth or process in the left valve, on which is placed the ligament, with a corresponding depression or socket beneath the umbo in the right valve. Impressions of the adductor muscles near the extremities, with a deeply sinuated line in the mantle-mark.

Animal of the form of the shell, with the mantle closed except in front for the emission of a small tongue-shaped foot. Tubes long, covered with a strong case-like coriaceous epidermis, separated at their extremities, with fimbriated orifices.

This genus is more especially characterised by the peculiar form of the hinge, which distinguishes it from all other Bivalves, and as now restricted contains but very few species in the recent state. They are confined to the colder regions of the globe, where they live buried in mud or sand, sometimes to the depth of a foot, in an erect position, with the siphonal extremity upwards, their tubes extending into the water; they have a vertical range from low-water-mark to upwards of 150 fathoms. Dead shells have been obtained from even greater depths, but it is no proof in such case of animals having a very extensive vertical range: Dr. Sutherland has shown, in regard to Arctic species, they are often transported by icebergs into very deep water.

The secondary fossils figured under this generic name have no relationship whatever; but a small species has been obtained from the upper marine of the Older Tertiary Periods that may be referred to this genus, showing then, as now, its somewhat estuary character, or its tendency to approach the regions of fresh-water.

1. MYA TRUNCATA, *Linnæus*. Tab. XXIII, fig. 1, *a—f*.

MYA TRUNCATA. *Linn.* Syst. Nat., ed. 12, p. 1112, No. 26, 1767.

— — *Gould.* Invert. Massach., p. 42, 1841.

— — *Möller.* Ind. Moll. Groenl., p. 21, 1842.

— — *Dekay.* Nat. Hist. New York Moll., p. 240, pl. 29, fig. 289, 1843.

— — *Phil.* En. Moll. Sic., vol. ii, p. 6, 1844 (fossil).

— — *Lovén.* Ind. Moll. Scand., p. 49, 1846.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 163, pl. 10, figs. 1, 2; and Animal, pl. II, fig. 1, 1848.

* Etym. *μύαξ*, a kind of shell-fish.

- MYA TRUNCATA. *Middendorff*. Malacozool. Rossica, p. 585, t. 19, figs. 13—15, 1849.
 — — *Lyell*. Trans. Geol. Soc., vol. vi, 2d series, p. 137, pl. 17, figs. 5, 6, 1839.
 — — *Forbes*. Mem. Geol. Surv., vol. i, p. 408, 1846.
 — — *Hancock*. An. and Mag. Nat. Hist., vol. 18, p. 337, 1846.
 — — var. PELAGICA. *King*. An. and Mag. Nat. Hist., vol. 18, p. 242.
 — OVALIS. *Turt.* Brit. Biv., p. 33, pl. 3, figs. 1, 2, 1822.
 — PULLUS. *J. Sow.* Min. Conch., t. 531.
 — SWAINSONI. *Lovén*. Ind. Moll. Scand., p. 49, 1846.
 SPHENIA SWAINSONI. *Turt.* Brit. Biv., p. 37, pl. 19, fig. 2, 1822.
 CHAMA TRUNCATA. *Da Costa*. Brit. Conch., p. 233, pl. 16, figs. 1, 1.
 — PHOLAS LATUS. *List.* Hist. Conch., pl. 482, fig. 269.

Spec. Char. Testá transversá, subovatá, inæquilaterali; anticè rotundatá, tumidá, clausá; posticè truncatá, hiantè; cardinis dente porrecto, rotundato.

Shell transverse, subovate, inequilateral; anterior side rounded, inflated, and closed; posterior truncated, and gaping; hinge with one large, rounded tooth.

Length, $3\frac{1}{2}$ inches. *Height*, $2\frac{1}{2}$ inches.

Locality. Cor. Crag, Ramsholt, and Gedgrave.

Red Crag, Sutton.

Mam. Crag. Chillesford, Bridlington.

Clyde Beds, Bracklesham, (*Dixon*).

Recent, British and Scandinavian Seas, Behring Straits.

This shell does not appear to have been rare in the Coralline Crag, the oldest Formation from which I have seen it; nor is it scarce in the Red Crag; and in the more recent Deposit at Chillesford it may be abundantly obtained in great perfection with the valves in their natural position. *Mya pullus* is the young of this species, and not of *arenaria*, as supposed by the authors of the 'Hist. of Brit. Moll.,' vol. i., p. 172. In my 'Catalogue,' I had assigned this as an identity with *M. ovalis*, Turt., and having found this shell in great profusion at Butley, not exceeding it in size, I considered it then as distinct.

This species is subject to considerable variation, more especially in regard to its length: those I have met with from the Coralline Crag are all of the longer variety; in the Red Crag the long and short are both obtained, but I have seen none there so short and obliquely truncated as the variety found fossil at Uddevalla; and in the Clyde Beds.* At Chillesford, all the specimens I have seen are of the longer variety; that is, with the siphonal side somewhat elongated, while, perhaps, it is somewhat

* The difference in the form of the mantle-mark in this variety was considered by the late Mr. G. B. Sowerby as a character of sufficient importance for a distinct position, and Mr. Smith, in consequence, proposed for it the name of *Uddevallensis*; but this mark is merely the result of the shortened side of the shell.

It is now well known that many of the species inhabiting the Arctic seas exhibit great variation, and still more abnormal forms, than are presented by the varieties of this species, have been recently obtained from that part of the world.

remarkable that the specimens of *Panopea Norvegica* found at this locality, where the general remains are decidedly of an Arctic character, have this side much abbreviated.

In the recent state it is found, sparingly, on the coast of the United States; and M. Middendorff* describes it as an inhabitant of the Sea of Okhotsk and the Behring Straits, appearing principally confined to the colder regions of the Northern Hemisphere.

This is the elder of the two species, and has in the living state a great geographical range, extending from the Behring Straits, through the Scandinavian and British Seas, to the coast of the New World westward, through Davis's Straits, and as far as Baring Island, where the short variety has been found in abundance. It is thus spread over an area of 280 degrees of longitude, and its range in depth is upwards of 100 fathoms. It was formerly an inhabitant of the seas which deposited the Sicilian Beds, where it is now found fossil, extending into this region probably during the Glacial Period, as it is no longer an inhabitant of the Mediterranean Sea.

2. MYA ARENARIA, *Linnaeus*. Tab. XXVIII, fig. 2, *a—f*.

- MYA ARENARIA. *Linn.* Syst. Nat., ed. 12, p. 1112, No. 27, 1767.
 — — *J. Sow.* Min. Conch., t. 364, 1822.
 — — *Gould.* Inv. Massach., pp. 40 and 359, 1840.
 — — *Nyst.* Coq. Foss. de Belg., p. 57, pl. 3, fig. 1, 1844.
 — — *Lovén.* Ind. Moll. Scand., p. 49, 1846.
 — — *Dekay.* Hist. New York Moll., p. 240, pl. 30, fig. 290.
 — — *Midd.* Malac. Rossica, p. 586, t. 20, figs. 1—3, 1849.
 — LATA. *J. Sow.* Min. Conch., t. 81, 1815.
 — — *W. Smith.* Strata Identif. Crag, fig. 9, 1816.
 — SUBOVATA. *Woodw.* Geol. of Norf., p. 43, t. 2, fig. 5, 1833.
 — SUBTRUNCATA. *Id.* Geol. of Norf., p. 43, t. 2, fig. 6.
 — MERCENARIA. *Say.* Journ. Acad. Nat. Sc., vol. ii, p. 313, fide *Gould*.
 — ACUTA. *Say.* Fide *Gould*, p. 40.
 CHAMA ARENARIA. *Da Costa.* Brit. Conch., p. 232.
 Dale. Hist. and Antiq. of Harwich, p. 293, t. 11, fig. 8, 1730.

Spec. Char. Testá transversá, ovatá, elongatá, subæquilaterali, crassá, rugosá; anticè rotundatá; posticè subacuminatá; cardinis dente denticulo laterali acuto.

Shell transverse, ovate, elongate, nearly equilateral, thick, and rough; anterior side rounded; posterior somewhat pointed; hinge tooth with a sharp lateral denticle.

Length, $3\frac{1}{2}$ inches. *Height*, $2\frac{1}{2}$ inches.

Locality. Red Crag, Sutton, Bawdsey, Felixstow.

Mam. Crag, Bramerton, Bridlington.

Bracklesham (*Dixon*).

Recent, Britain, Scandinavia, and N. E. Coast of America.

* The figure by Middendorff is not the short variety.

This species I have not as yet seen from the Lower or Coralline Crag; and although abundant in the Red Crag, I have never found anything but detached valves, and those in the more disturbed portion of that Formation.

It is subject to great variation; and I think, with the authors of the 'Hist. of Brit. Mollusca,' that the shell called *lata* by Mr. Sowerby, above referred to, is only a modified form of this species, although presenting an intermediate character between the truncated posterior of *truncata* and pointed termination of the ordinary form of the living shell, depending probably upon some peculiarly local conditions, as I have never met with it but in one locality. The form of the spatulate tooth in the hinge of this variety is precisely like that of the recent *arenaria*. It was furnished with a large and strong ligament, or rather cartilage, the greater part of which is preserved in most of the fossil specimens.

The cause assigned for this variation (*lata*), by the authors of the 'Hist. of Brit. Mollusca,' appears to me to be somewhat doubtful, this not being, I believe, one of the forms found in the estuary portion of the Mammaliferous Crag, where distortions are by no means rare, and where, in all probability, the influx of ice or the efflux of more than ordinary quantities of fresh water, produced deformities like some of the specimens of *Purpura lapillus* and *Littorina littorea*, found in that Deposit. The variation in *lata* does not appear to be a distortion, as understood in this case, but a character that pervaded a whole race, making it what is called a permanent variety.

The depth of the pallial sinus is a character here not to be much depended upon, as, in my large series, considerable differences in regard to depth may be observed; for in some specimens this mark extends considerably beyond the hinge ligament, while in others it falls short of it, being modified by the length of the tubes, which would probably vary under the influence of external conditions.

This, in the living state, is generally a very shallow-water species, burying itself in sand, near low-water mark; extending, at times, into rivers as far as where the water, when the tide is out, is nearly fresh. Its geographical distribution takes in the whole circuit of the Northern Hemisphere, being found, according to Middendorff,* at Sitka, in the Sea of Okhotsk, on the coast of Russian Lapland, and Nova Zembla, and, by the American authors, on the coast of the United States, as far to the southward as nearly to 40°, exhibiting thus an equal, or perhaps a greater, extent of range than its elder confrère, *truncata*. It has not had, however, on our side of the Atlantic, quite so great a range to the southward, not having been found, either recent or fossil, in or near the Mediterranean.

The animal of this species is, according to Dr. Gould, extensively employed as bait in the cod fisheries of Newfoundland, and is called the long clam, to distinguish it from the giant clam, *Maclra gigantea*, or the round clam or Quahog, *Venus mercenaria*.

* The specimen figured by Middendorff appears rather distorted, with a short siphonal side.

PANOPEA.* *Menard de la Groye*, 1807.

MYA (sp.) *Linn. Broc.*

CHAMÆPHOLAS (sp.) *Petiver.*

GLYCIMERIS. *Lamk.* 1812.

PANOPEA. *Goldf. Phil. Bronn. Valenciennes.*

PANOPIA. *Swains.* 1840.

PANOPOEA. *Nyst.* 1844.

HOMOMYA (sp.) *Agass.* 1845.

Generic Character. Shell transversely oblong, equivalved, inequilateral, more or less gaping at both extremities; surface smooth or marked by rough and somewhat irregular lines of growth; elongated impressions by the adductors; mantle-mark with a large, deep sinus; hinge furnished with one conical tooth in each valve; ligament external, placed on a prominent fulcrum.

Animal with very long and extensible siphonal tubes united to their extremities; mantle closed throughout its length, except a small opening in front for the passage of a short, stout, muscular foot; large and strong adductor muscles.

This genus is closely related to *Mya*, in the animal as well as in the shell, differing principally by the position of the hinge-ligament, which in this is placed upon a prominent ridge, and its action consequently different. The animal has very long siphonal tubes, which are incapable of being withdrawn into the shell, and are consequently thickened, and covered with a strong coriaceous epidermis.

In 1839, M. Valenciennes published a valuable monograph of this genus, and described the animal of one species found on the shore of Port Natal, which seems to have been an inhabitant of shallow water, and left dry at the retreat of the tide. Its tubes were observed protruding through the sand, and when alarmed retreated backward by means of its powerful foot to the depth of several feet.

Some of the Oolitic Fossils belong to this genus.

Dr. Gray considers the name of *Glycimeris*, proposed by Klein, 1753, as entitled to be used for this genus, but the date is anterior to our starting point, viz. the 12th ed. Linn., 1767.

1. PANOPEA NORVEGICA, *Spengler.* Tab. XXIX, fig. 1, *a—e.*

MYA NORVEGICA. *Speng.* Skrivt. Natu. Silskal, vol. iii, part 1, p. 46, pl. 2, fig. 18.

GLYCIMERIS ARCTICA. *Desh.* 2d ed. Lamarck, tom. vi, p. 70, 1835.

— NORVEGICA. *Gray.* List Brit. Moll., p. 63, 1851.

PANOPEA GLYCIMERIS. *Bean.* Mag. Nat. Hist., viii, p. 562, figs. 50, 51.

* Etym. *Panope*, one of the Nereids. *Panopea*, Hubn. 1816, a genus of *Lepidoptera*.

- PANOPEA ARCTICA. *Gould.* Inv. Massach., p. 37, fig. 27, 1840.
 — — *Dekay.* Nat. Hist. New York Zool., p. 246, 1843.
 — — *King.* Ann. and Mag. Nat. Hist., vol. xviii, p. 243, 1846.
 PANOPEA BIVONÆ. *J. Smith.* Wern. Mem. vol. viii, p. 107, pl. 2, fig. 4, 1839.
 — — *Phil.* En. Moll. Sic., vol. i, p. 8, t. 2, fig. 1, *a—c*, 1836.
 — SPENGLERI. *Valen.* Arch. du Mus., tom. i, p. 15, pl. 5, fig. 3, 1839.
 — — *Chenu.* Illust. Conch. Panopæa, pl. 4, fig. 2, 4, 4 *a*, 4 *b*; pl. 6, fig. 3, *a*, *b*; and pl. 10, fig. 2, *a*, *b*.
 — NORVEGICA. *J. Sow.* Min. Conch., t. 610, fig. 2, and 611, figs. 1, 2.
 — — *Lovén.* Ind. Moll. Scand., p. 49, 1846.
 — — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 175, pl. 11, 1848.
 — — *Middend.* Malacozool. Rossica (Mem. *loc. cit.*), p. 593, t. 20, fig. 11, 1849.

Spec. Char. *Testá crassá, oblongá vel subrhomboidali, plus minusve inæquilaterali; anticè plerumque breviorè, porticè truncatá et latiorè; cardine edentulo? impressione pallii, interrupta, maculosa.*

Shell thick, oblong or somewhat rhomboidal, more or less inequilateral; anterior side generally the shorter, posterior truncated and broader; hinge without teeth; impression by the mantle interrupted, spotted and irregular.

Length, 3 inches. *Height*, 2 inches.

Locality. Red Crag, Sutton, Butley.

Mam. Crag, Chillesford, Bridlington.

Clyde Beds, and Sicily.

Recent, North America, Britain, Scandinavia, Russian Lapland, and Sea of Ochotsk.

As yet this shell has been but sparingly obtained from the Red Crag, but it does not appear to be very scarce in the native bed at Chillesford, where the valves are met with in their natural position. Although my specimens from the Red Crag do not amount in number to more than half a dozen, there is a considerable variation among them.

Our fossils are in general more equilateral, that is to say, the siphonal side of the shell is less in size, particularly those from Chillesford, than the living specimens, or those from the newer Tertiaries of Sicily, where the anterior side does not constitute more than a third of the entire shell; there is, however, no doubt as to the identity of the British fossil with the recent species. Among other minor differences may be mentioned the ligamental fulcra, which in Crag specimens extend half way across the dorsal margin, giving support to large and powerful ligaments, while in the living shell this fulcrum is much smaller. The adductor muscle-marks are deeply impressed, the shell gapes widely on the posterior side, and there is a considerable opening in the fore part of the ventral margin for the extrusion of the foot: the surface is much roughened by somewhat irregular lines of growth; and the centre of the shell is contracted or depressed, giving it a couple of obtuse ridges which diverge from the umbo.

In the living state it has been only obtained in deep water.

A small obtuse tooth occupies a position immediately beneath the umbo in the living shell, but in the fossil this is merely rudimentary.

The figure by Middendorff has the siphonal side the larger.

2. *PANOPEA FAUJASII*, *Menard de la Groye*. Tab. XXVII, fig. 1, *a—f*.

- PANOPEA FAUJASII*. *Men. de la Groye*. Ann. du Mus., tom. ix, p. 131, t. 12, 1807.
 — — *Dubois de Montp.* Conch. Foss. de Wolhyn. Podol., p. 51, pl. 4, figs. 1—4, 1831.
PANOPEA FAUJASII. *Bast.* Foss. de Bord., p. 95, 1825.
 — — *Bronn.* Leth. Geog., p. 973, pl. 37, fig. 6, 1838.
 — — *Phil.* En. Moll. Sic., vol. i, p. 7, t. 2, fig. 3, 1836.
 — — *Goldf.* Pet. Germ., vol. ii, p. 274, t. 159, fig. 1, *a—d*.
 — — *Valenciennes.* Arch. du Mus., vol. i, p. 13, 1839.
 — — *J. Sow.* Min. Conch., t. 602, figs. 3—5.
 — — *Chenu.* Conch. Illust., pl. 4, fig. 1, 1.
 — *IPSVICIENSIS.* *J. Sow.* Min. Conch., t. 611, figs. 3, 4.
 — — *Valenciennes.* *Loc. cit. sup.*, No. 36.
 — *REFLEXA.* *Say.* Journ. Acad. Nat. Sc., vol. iv, p. 153, pl. 13, fig. 4, 1824.
 — — *Conrad.* Foss. Med. Tert., p. 5, pl. 3, fig. 4, 1838.
 — *AMERICANA.* *Id.* Foss. Med. Tert., p. 4, pl. 2.
 — *ALDROVANDI?* *Phil.* En. Moll. Sic., vol. i, p. 7, t. 11, fig. 2.
 — *GENTILIS.* *J. Sow.* Min. Conch., vol. vii, t. 610, fig. 1, 1840.
MYA PANOPEA? *Broc.* Conch. Foss. Subap., p. 532, 1814.

Spec. Char. *Testá transversá, ovato-oblongá, inflatá; plus minusve inæquilaterali; posticè truncatá et valdè hiantè; cardine unidentato.*

Shell transverse, ovately oblong, inflated, more or less inequilateral; posterior side truncated, and gaping widely; hinge with one tooth.

Length, 6 inches. *Height*, $3\frac{1}{2}$ inches.

Locality. Cor. Crag, Sudbourn, Gedgrave, Ramsholt.

Red Crag, Sutton.

This handsome shell is very abundant as a Crag Fossil, though its great size and comparative thinness has caused it to be somewhat scarce in our Cabinets: at Ramsholt numerous specimens were found with the valves united. It presents a very considerable variation, both in regard to its form, and to the degree of gape on the anterior side, and I am inclined to believe the recent Mediterranean shell called *P. Aldrovandi* is merely the descendant of our Crag species somewhat altered by local conditions: the Sicilian fossil (specimens of which were obligingly given to me by Madame Power) seems to present some differences; but they are not, I think, of sufficient importance for specific distinction; that shell is, in general, rather more inequilateral than the Crag one, but not always so; and, among my British specimens

a considerable variation in that character may be observed. Great reliance has been placed upon the size of the gape for the foot on the anterior side, but I believe such distinction to be of very little value, as in some of my specimens it is nearly closed, while in others it is widely open, and with all intermediate magnitudes. The variety *Ipsviciensis*, found at Ramsholt, appears to differ most from the Sicilian shell, and may be considered its extreme range in variation, being more equilateral and straight; but some of my specimens from near Orford, have nearly the same inequilaterality as the Sicilian fossil, with the like obliquity. In *P. Norvegica*, a difference exists between the comparative magnitudes of the two sides of the recent, as well as between the Sicilian fossil, and my specimens from Chillesford, equally evident with what may be seen in this species; and the comparatively greater depth of the sinus results, I conceive, in this difference between the two sides, the sinus reaching further back, or apparently deeper, in those which are more equilateral than where the siphonal side is so much the larger. Similar differences exist in *Mya truncata*; what has been called *M. Uddevallensis* has one side of the shell very short, giving a material difference in proportional dimensions from some undoubtedly of the same species from the Coralline Crag, as well as from the more southern portion of the English Coast, as if a northern locality had induced an alteration in that character.

I have given figures of the specimen from the Red Crag, called *P. gentilis* (fig. 1, *d, e*), which Mr. Sowerby considered as a distinct species. With the exception of its being a little more elongated, its characters are so similar to those of fig. 1, *a*, that I believe it to be only an aberrant form of the one abundant in the Coralline Crag. The apparent greater depth in the sinus of the mantle-mark, in this specimen, I would attribute entirely to its elongated and constricted form: a considerable difference in the siphonal scar may be observed in a large series depending in a great degree upon the outward form of the shell.

Figs. 3, 4, 5, of the 'Mineral Conchology,' t. 602, are probably fragments of this; but figs. 1 and 2, of the same Plate, described under the name of *P. Faujas*, belong, I believe, to another species.

SAXICAVA.* *Fleureau de Bellevue*, 1802.

MYTILUS (sp.) *Linn. Mont. &c.*

SOLEN (sp.) *Linn. Mont. &c.*

MYA (sp.) *Linn. Fabr. &c.*

DONAX (sp.) *Poli.*

ANATINA (sp.) *Turton.*

CARDITA (sp.) *Bruguière.*

IRUS (sp.) *Oken.*

CHAMÆPHOLAS (sp.) *Lister.*

ARCINELLA (sp.) *Phil.* 1844. Not *Schum.*

HIATELLA. *Dand.* 1800. *Gray*, 1851.

CLOTHO? *Fauj. St. Fond.* 1807.

BYSSOMIA. *Cuv.* 1817.

DIDONTA. *Schum.* 1817.

PHOLEOBIA. *Leach*, 1819.

BIAPHOLIUS. *Id.* 1819.

RHOMBUS. *Blainv.* 1818.

AGINA. *Turt.* 1822.

RHOMBOIDES. *Blainv.* 1825.

* Etym. *Saxum*, a rock; and *cavo*, to make hollow.

Generic Character. Shell transverse, inequilateral, oblong, or subrhomboidal, equivalve, slightly gaping at both extremities, sometimes in front; hinge with one or two cardinal teeth, which are generally obsolete when full grown; muscular impressions ovate, strong, and distant; pallial impression somewhat irregular, with a small or moderate sinus. Ligament external.

Animal oblong, or club-shaped; mantle united, except where open in front for the passage of a digitiform foot, furnished with a byssal groove; siphons short, separated at their extremities; branchial and anal orifices large, margined with cirrhi.

Animals of this genus are generally found located in rocks, as the name imports, and they are often met with in those situations into which they must have entered at a very early age, their extrication being effected only by a fracture of the stone from depths of sometimes nearly six inches. It is therefore evident this aperture is formed by the animal itself, and as the crypts are not symmetrical, like those of the *Pholades*, the mechanical theory of a rotatory motion, by the rasping of the shell, will not in this instance satisfactorily explain the *modus operandi*. They appear endowed with the power of spinning a byssus, by which they are sometimes moored to the sides of the cells, and occasionally the ventral opening is of considerable size; from which circumstance a genus was formed by Baron Cuvier, under the name *Byssomya*, for the reception of those shells possessing this character.

Their peculiar habits producing often great distortion, and their extraordinary variation, have caused much perplexity to the naturalist; the same species has, I believe, been placed in five different genera; and the most distinguished conchologists of the present day are still at variance, not only in the determination of the species to which the shells now found on our own coasts should be assigned, but even the generic limits cannot be agreed upon. A small shell from the Older Tertiaries of this country is in the Cabinet of Mr. Edwards, probably belonging to this genus; and M. Deshayes has described some species from the Paris Basin.

1. *SAXICAVA RUGOSA*, *Pennant*. Tab. XXIX, fig. 3, *a—g*.

MYTILUS RUGOSUS. *Penn.* Brit. Zool., ed. 1, vol. iv, p. 110, t. 63, fig. 72.

— *PHOLADIS.* *Müll.* Zool. Dan., t. 87, figs. 1—3.

— — *Chemn.* Conch. Cab., vol. viii, p. 154, t. 82, fig. 735.

MYA BYSSIFERA. *Otho. Fabr.* Faun. Groenl., p. 408, No. 8.

— *RUSTICA.* *Broc.* Conch. Foss. Subap., p. 533, t. 12, fig. 11, 1814.

SAXICAVA RUGOSA. *Forb. and Hanl.* Brit. Moll., vol. i, p. 146, pl. 6, figs. 7, 8; and pl. F, fig. 6.

— — *Lyell.* Trans. Geol. Soc., 2d series, vol. vi, pl. 16, fig. 7, 1839.

— — *J. Sow.* Min. Conch., t. 466.

— — *Phil.* En. Moll. Sic., vol. i, p. 20, t. 3, fig. 4, 1836.

— *STRIATA.* *Fl. de Bellevue.* Journ. de Phys., tom. liv, p. 349, 1802.

— *GALLICANA.* *Desh.* 2d ed. Lamarck, tom. vi, p. 162, 1835.

- SAXICAVA PHOLADIS. *Turt.* Brit. Biv., p. 21, t. 2, figs. 11, 1822.
 — — *Hancock.* Mag. Nat. Hist., vol. xviii, p. 337.
 — DISTORTA. (*Say.*) *Gould,* Inv. Massach., p. 61, fig. 40.
 — SULCATA. *Smith.* Phil. Trans., 1835, pl. 2, fig. 25.
 PHOLEOBIA RUGOSA. *Leach.* Ross's Voy. Baff. Bay, p. 174, 1819.
 BIAPHOLUS RUGOSUS. *Leach* MS. An. and Mag. Nat. Hist., vol. xx, p. 272.
 BYSSOMYA PHOLADIS. *Bowdich.* Bivalves, fig. 43.
 RHOMBOIDES RUGOSUS. *Blainv.* Man. Malac., p. 573, 1825.
 HIATELLA OBLONGA. *Turt.* Brit. Biv., p. 25, pl. 2, fig. 13, 1822.
 — RUGOSA. *Flem.* Brit. An., p. 461, 1828.

Spec. Char. *Testá variabile, oblongá, vel subrhomboidali transversim striatá, rugosa; utraque extremitate obtusá, aliquando valvarum angulis binis instructo: latere antico brevissimo.*

Shell variable, oblong or subrhomboidal, transversely striated, and rugose; obtuse or rounded at each extremity; sometimes furnished with two diverging rows or slightly imbricated ridges; anterior side much the shorter.

Length, 1 inch. *Height*, $\frac{5}{8}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton, Walton Naze.

Clyde Beds, Bridlington.

Recent, Britain, Mediterranean, Scandinavia, N. E. Coast of America,
 Nova Zembla, Sea of Ochotsk, and Sitka.

Small specimens of this shell are abundant in the Cor. Crag. In the Red Crag they are sometimes met with, in loose sand, with the valves united, much distorted, and with a large, ventral opening. The gigantic specimens obtained in the Clyde Beds, and in the recent Deposits of Canada, belong, I believe, to nothing more than a variety of this species, where, apparently under favorable circumstances, it had attained to so great a magnitude; but one of my specimens from the Red Crag is not much less, giving every reason to suppose the simple difference in size, if not merely a difference in age, may be the result of different conditions; the Red Crag specimens bearing in general a sort of intermediate character, as if a reduction in temperature from the older to the more modern Periods had been favorable to the fuller development of this species.

Large numbers of individuals are found loose in the Crag, and when in a living state, probably passed their lives in adhering by a byssus to the roots of *Fuci*. Mr. Sowerby, in 'Min. Conch.,' speaks of a specimen having been found imbedded in *Septaria*, beneath the Red Crag at Holywells. I have never met with the British fossils otherwise than in localities where, I believe, they were not excavators. This species appears to be generally distributed through the Drift Beds in this country, and it is also found in similar Deposits in Canada, Sweden, and Russia. Mr. Smith, of Jordan Hill, has recently forwarded to me the drawing by the late Professor E. Forbes,

of an individual measuring $1\frac{3}{4}$ inch long, and $\frac{7}{8}$ ths of an inch high, which was thought to be distinct from *rugosa*, and called *striata*. I cannot coincide in that opinion; it appears to me to be only a monstrous form of our variable shell.

2. *SAXICAVA ARCTICA*, *Linnæus*. Tab. XXIX, fig. 4, *a—b*.

- MYA ARCTICA*. *Linn.* Syst. Nat., ed. 12, p. 1113.
CARDITA LITHOPHAGELLA. *Costa*. Fide *Phil*.
MYA ELONGATA. *Broc.* Coq. Foss. Subap., p. 529, t. 12, fig. 14, *a, b*, 1814.
HIATELLA ARCTICA. *Daud.* Rec. Mem. Moll., 1800.
ANATINA ARCTICA. *Turt.* Brit. Biv., p. 49, pl. 4, figs. 7, 8, 1822.
SAXICAVA ARCTICA. *Phil.* En. Moll. Sic., vol. i, p. 20, t. 3, fig. 3, 1836.
— — *Lovén.* Ind. Moll. Scand., p. 40, 1846.
— — *D'Orbigny.* Moll. Canar., p. 109, No. 195, 1835.
— — *Nyst.* Hist. Coq. Foss. Belg., p. 95, pl. 3, fig. 15, *a—c*, 1844.
— *RUBRA*. *Desh.* Expéd. Algér. Moll., pl. 66, figs. 18, 19.
SAXICAVA RHOMBOIDES. *Desh.* 2d ed. Lamarck, tom. vi, p. 153, 1835.
SOLEN MINUTUS. *Linn.* Syst. Nat., ed. 12, p. 1115, No. 42.
— — *Mont.* Test. Brit., p. 53, pl. 1, fig. 4, 1813.
— *PURPUREUS*. *Flem.* Brit. An., p. 459, 1828.
HIATELLA MINUTA. *Turt.* Brit. Biv., p. 24, pl. 2, fig. 12, 1822.
— — *Gray.* List. Brit. Moll., p. 89, 1851.
TELLINA RHOMBOIDES. *Poli.* Test. Sicil., p. 81, t. 15, figs. 12, 13, 15; and t. 14, fig. 16.
DONAX IRUS. *Olivi.* Fide *Philippi*.
MYTILUS PRÆCISUS. *Mont.* Test. Brit., p. 165, t. 4, fig. 2, 1803.
PHOLEOBIA PRÆCISA. *Brown.* Illust. Brit. Conch., t. 9, fig. 16.
AGINA PURPUREA. *Turt.* Brit. Biv., p. 54, t. 4, fig. 9.
DIDONTA BICARINATA. *Schum.* Essai, p. 125, pl. 6, fig. 2, *a, b*, 1817.
BIAPHOLIUS SPINOSUS. "*Leach.*" Ann. Mag. Nat. Hist., vol. xx, p. 272.
HYPOGÆA GIBBA. *Poli.* Test. Sic., vol. i, p. 251.

Spec. Char. *Testá crassá, oblongá, vel rhomboidali, valdè inæquilaterali; concentricè striatá, aut rugosá; latere antico brevissimo; biserialim obliquè aculeis instructo: cardine unidentato.*

Shell thick, oblong or rhomboidal, very inequilateral; rugose or irregularly striated with lines of growth; anterior side very short; ornamented with two diverging imbricated ridges: hinge with one tooth.

Length, $\frac{5}{8}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton.

Recent, Canary Islands, Mediterranean, Ægean, British and Norwegian Seas.

In deference to the malacologists, I have separated these two shells, and placed them as distinct species, under the names *arctica* and *rugosa*, though I believe there is no ground for the distinction.

The form of the shell, and the inequilaterality of the valves are not to be depended upon for specific separation, neither can any reliance be placed upon the two diverging ridges upon the siphonal side, though strongly marked in this, where often these ridges are imbricated; the same character may generally be detected in the younger portion of the preceding, becoming obliterated in the older shell, and what is called the excavated lunule,* which is said by the recent conchologists to be the tangible mark of distinction between the two, is as prominent and evident in the one as in the other.

The remark made by Dr. Gould upon *Saxicava distorta* may be also applied to our fossils: "it is a perfect Proteus, of which no description can be given that is not liable to mislead." The American shell being probably only a variety of a species that seems to have a geographical extension reaching from the Ægean to the northernmost shores of Finmark, and the N. E. coast of America.

Saxicava bilineata, Conrad, 'Foss. of the Mid. Tert. of the United States,' p. 18, Pl. 10, fig. 4, is probably another variety of this species.

The only imprisoned specimen I have ever found in the Crag, was in the interior of one of the large barnacles. I have a recent individual from the Bay of Smyrna, it was imbedded in sponge.

3. SAXICAVA? FRAGILIS, Nyst. Tab. XXIX, fig. a—e.

SAXICAVA FRAGILIS. Nyst. Coq. Foss. de Belg., p. 97, pl. 4, fig. 10, a, b, 1844.

? — RUGOSA, juv.? Forb. and Hanl. Hist. Brit. Moll., vol. i, p. 149, pl. 6, figs. 1—3, 1848.

— — var. Gray. List Brit. Moll., p. 88, 1851.

SPHENIA CYLINDRICA. S. Wood. Catalogue, 1840.

Spec. Char. Testá oblongá, vel subcylindraccá tenui, fragili, inæquilaterali, leví (præter strias incrementi irregulares) latere postico obtusè angulato; cardine unidentato.

Shell oblong, or subcylindrical, thin, fragile, inequilateral, smooth (except the irregular lines of growth); posterior side with an obsolete, angular ridge; one cardinal tooth.

Length, $\frac{3}{4}$ inch. *Height*, $\frac{3}{8}$ inch.

Locality. Cor. Crag, Sutton.

Very abundant. All my specimens were found free and loose in the sand with the valves separated.

Our shell in its young state is furnished with one cardinal tooth, and a depression for its reception in each valve; and, like *Saxicava*, these teeth become obsolete when

* There is no distinct lunule in these shells, the appearance of such is produced simply by an obsoletely-curved ridge in the shell, on the anterior side.

the shell is full grown. There is a small sinus in the mantle-mark, and the impressions of the adductors are very distinct. Within these, on both sides, a ridge diverges from beneath the umbo; that on the anterior side is the more prominent. The ligament appears to have been supported upon a prominent fulcrum, while the cartilage was placed in a depressed line upon the dorsal edge, and there is a small gape on the siphonal side.

The shell above referred to, in the 'Hist. of Brit. Moll.,' may possibly be the descendant of our fossil, as I had supposed when compiling my Catalogue, (Ann. and Mag. of Nat. Hist., 1840, p. 245, *infra*), but several dead valves of the recent species, since obtained from the beach on Stone Point, at Walton Naze, cast a doubt upon that identification, the recent shell having the siphonal side much broader than the anterior, and is not quite so flat.

I have no doubt of our fossil being distinct from *Saxicava arctica*, nor do I think there is any good reason for believing it to be the fry of some larger species. It is difficult to determine where it ought to be placed, but it appears to conform more nearly with the diagnosis of *Saxicava* than with any other existing genus. I would have adopted *Arcinella*, proposed by Philippi for the succeeding species, but that this name had been twice previously used in the class *Mollusca*; and *Sphenia*, the genus in which I had provisionally placed it, has a different hinge with an internal ligament like that of *Mya*, placed upon a spatulate projection.

3. SAXICAVA? CARINATA? *Brocchi*. Tab. XXIX, fig. 5, *a—e*.

MYTILUS CARINATUS? *Broc.* Coq. Foss. Subap., p. 585, t. 14, fig. 16.

— — ? *Goldf.* Pet. Germ., p. 179, pl. 131, fig. 14.

ARCINELLA CARINATA. *Phil.* En. Moll. Sic., vol. ii, t. 16, fig. 9.

SPHENIA ANGULATA. *S. Wood.* Catalogue, 1840.

Spec. Char. . *Testá minutá, transversá, oblongá, valdè inæquilaterali, tenui, fragili; anticè brevì, posticè carinatá, angulatá, productá, granulosá; cardine unidentato.*

Shell minute, transverse, oblong, very inequilateral, thin, and fragile; anterior side short, posterior angulated, carinated, and produced, with a granular surface; hinge with one tooth.

Length, $\frac{1}{2}$ inch. *Height*, $\frac{1}{4}$ inch.

Locality. Cor. Crag, Sutton.

A few specimens only of this species have come under my observation, and those are all in my own cabinet.

The shell it most resembles is the preceding, from which, however, it differs in having the siphonal side much more angular, pointed, and carinated, with also a roughened or shagreen-like exterior, most distinctly visible on the posterior slope.

There is one obtuse tooth, most prominent in the right, with a corresponding depression in the left valve, and the anterior muscular impression is of an ovate form, deeply impressed.

I have assigned it, with some degree of doubt, as an identity with the Italian fossil, depending upon the very imperfect figure by Brocchi. It accords with his description, except that it is not "smooth," as he describes it; but some of my specimens appear to have lost their granular exterior, and this may have been the case with the sub-Apennine fossil.

An American shell from the Older Tertiaries, *Byssomya petriculoides*, Lea, 'Contrib. to Geol.,' p. 48, pl. 1, fig. 16, though evidently distinct, more nearly approaches this species than *Saxicava arctica*, to which it has been considered to have belonged.

Philippi has given the representation of a fossil under the name of *Arcinella carinata*, which I have considered as this species, and he refers to *Mytilus carinatus*, Brocchi; but there is no description to assist in its determination, and my dependence is entirely upon his figure. *Arcinella lævis*, of the same author, vol. ii, p. 54, t. 16, fig. 10, probably belongs to a different genus; it looks like the left valve of *Montacuta bidentata*.

GLYCIMERIS,* Lamk. 1801.

CYRTODARIA. Daudin, 1792. Fide Gray.

Generic Character. Shell equivalved, inequilateral, elongately oblong, thick, strong, flattish or compressed, gaping widely at each extremity. Hinge edentulous; ligament external. In the recent state covered with a thick epidermis. Two deep impressions by the adductor muscles, with a small sinus in the rugged and irregularly-shaped mantle-mark.

Animal of the form of the shell, with the lobes of the mantle thick, and the edges, united, except immediately in front, where there is an opening for the passage of a small cylindrical foot; siphons united to their extremities, thick, and fleshy, with a wrinkled epidermis, and incapable of being withdrawn into the shell; orifices fringed; branchiæ long and thick, two on each side.

One recent species only of this genus has yet been noticed, and that has been long known. It is an inhabitant of the arctic regions, and the N. E. Coast of America, but not met with in our own seas. The animal of this has been examined by M. Audouin, and its details published in the 'Ann. des Sc. Nat.,' 1833, from which it appears to have somewhat of an isolated position. M. de Blainville placed it among the *Naiades*. In the shell and its hinge-furniture it has considerable resemblance to *Panopea Norvegica*.

In Mr. Edwards's cabinet is a species from the lower division of the Older Tertiaries.

* Etym. γλυκίς, dulcis, and μερίς, a species so called by Pliny from its sweet taste.

1. GLYCIMERIS ANGUSTA, *Nyst* and *Westendorp*. Tab. XXIX, fig. 2, *a—d*.

GLYCIMERIS ANGUSTA. *Nyst* and *West*. Nouv. Rech. Coq. Foss. d'Anv. (Bull. de l'Acad. des Sc. de Bruxelles, tom. vi, 1839), p. 4, pl. 1, fig. 1.

— — *Nyst*. Coq. Foss. de Belg., p. 55, pl. 11, fig. 1, 1844.

— VAGINA. *S. Wood*. Catal. of Crag Shells in Ann. and Mag. Nat. Hist., vol. vi, p. 245, 1840.

— — *J. Sow*. Min. Conch., t. 636, 1844.

Spec. Char. *Testá elongato-oblongá, crassá, rugosá, tortá, valdè inæquilaterali; posticè breviorè, truncatá, subangulatá; anticè productá, attenuatá; valvis intus incrassatis.*

Shell elongately oblong, thick, rough and twisted, and very inequilateral; posterior side the shorter, truncated, and somewhat angular; anterior produced, slightly pointed; valves thickened within.

Length, 4 inches. *Height*, $1\frac{1}{2}$ inch.

Locality. Cor. Crag, Gedgrave, Sudbourn, and Ramsholt.

Red Crag, Sutton.

This strong shell is by no means rare in the Coralline Crag, and fragments of it are not unfrequently met with in the Red Crag. Some differences exist between this and the recent species, *Mya siliqua*, Chemn., vol. ii, p. 192, t. 198, fig. 1934; the siphonal side being shorter in the Crag shell, as well as broader, and the anterior more pointed; there is also a greater twist or contortion in the valves, and the muscular impressions are somewhat different; that of the anterior adductor is more elongated, increasing in breadth towards the anterior, and extending to the verge of the impression by the mantle on that side; the posterior adductor is situated further backward than in the recent shell, almost touching the extreme edge, below which is the small sinus of the mantle-mark. The shell is much twisted, so that the valves, when united, touch only at the hinge and basal edge of the anterior margin. There is a large and prominent fulcrum for the ligament, extending nearly to the posterior extremity of the shell; between it and the umbo is a cavity for the cartilage, with a callosity or obscure tooth immediately under the beak.

There is a slight appearance of erosion at the umbones of some of my specimens, and the exterior is smooth, with the exception of lines of growth. Traces of irregular lines may be sometimes seen both longitudinally and transverse; these were probably produced by the rugosities of its thick epidermis.

In this, contrary to the generality of Bivalves, the siphonal side is much the shorter of the two.

A recent species of this Genus is in the cabinet of my friend J. W. Flower, Esq., said to be from Moreton Bay. It approaches rather nearer to our fossil than does the Arctic shell, in having a greater twist, but it differs also slightly in form.

GASTROCHÆNA,* *Spengler*, 1783.UPEROTUS (part). *Guettard*, 1774.CHÆNA (part). *Retzius*, 1788.MYA (sp.) *Pennant*.PHOLAS (sp.) *Chemn. Poli*.FISTULANA (sp.) *Brug*. 1792.TRAPEZIUM (sp.) *Megerle*, 1811.GASTROCHINA. *Swains*. 1840.

Generic Character. Shell equivalve, inequilateral, oval or wedge-shaped, with a large ventral opening; hinge linear; a single laminated obscure tooth in each valve. Ligament external.

Tube calcareous, pyriform; posterior opening narrow, with a bipartite or divided aperture.

Animal cuneiform, siphons united to their extremities, orifices fringed, mantle closed, with the exception of an opening for a small, finger-shaped, curved, and pointed foot, sometimes furnished with a delicate byssus.

Animals of this genus are generally enclosed in the thick shelly substance of some mollusc, or in the centre of a mass of coral, their excavations being produced by an operation of the animal itself. The mode by which this is effected is not yet satisfactorily determined, a difference of opinion still existing as to whether it is caused by the action of a solvent, or by the mechanical operation of surface abrasion.

Some specimens do not attempt to excavate, but merely to enclose themselves in their own flask-like cases, to which occasionally foreign materials are added.

Species of this genus have been found in the Oolite Formations, and in the Older Tertiaries, but nowhere in any abundance.

1. GASTROCHÆNA DUBIA, *Pennant*. Tab. XXX, fig. 11, *a—d*.MYA DUBIA. *Penn.* Brit. Zool., vol. iv, p. 82, pl. 44, fig. 19, 1777.CHAMA PARVA. *Da Costa*. Brit. Conch., p. 234, 1778.MYA PHOLADIA. *Mont.* Test. Brit., p. 28, 1803; and Supp., p. 20, 1808.PHOLAS FABA. *Pulteney*. Hutchin's Hist. Dorset, p. 27.GASTROCHÆNA MODIOLINA. *Lamk.* Hist. des An. s. Vert., tom. v, p. 447, 1818.

— — *Forb. and Hanl.* Hist. of Brit. Moll., p. 132, pl. 2, figs. 5—8, pl. F, fig. 5.

— PHOLADIA. *Turt.* Brit. Biv., p. 18, pl. 2, figs. 8, 9, 1822.— — *Lukis.* Mag. Nat. Hist., vol. vi, p. 404, fig. 52, *a—g*.— CUNEIFORMIS. *Phil.* En. Moll. Sic., vol. i, p. 2, 1836.— POLII. *Id.* „ „ „ vol. ii, p. 3, 1844.— HIANS. *Flem.* Hist. Brit. An., p. 458, 1828.— FULVA. *Leach*, MS. 1818. Ann. Mag. Nat. Hist., vol. xx, p. 272.— DUBIA. *Desh.* Traité Elém. Conch., pl. 2, figs. 4, 5.— POLIANA. *Phil.* In Wiegman Archiv. Nat., pl. 7, fig. 1, 1845.

* Etym. γαστήρ, ventral, and χαινω, to gape.

GASTROCHÆNA FABÆ. "Leach, MS." 1817. Fide Gray.

MYTILUS AMBIGUUS. Dillw. Cat. of Recent Shells, p. 304, No. 9.

PHOLAS PUSILLA. Poli. Test. Sic., vol. i, p. 50, t. 8, figs. 12, 13, 1791.

Spec. Char. Testâ elongatâ, cuneiformi, tenui, fragili; hiatu magno ovato; striis incrementi valdè conspicuis; umbonibus subterminalibus vix prominulis; cardine subcalloso.

Shell elongate, wedge-shaped, thin and fragile, with a large ventral gape; lines of growth conspicuous; beaks nearly terminal, scarcely prominent; hinge with an obtuse callosity.

Length, $\frac{2}{3}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton.

Recent, Mediterranean, Britain.

Numerous fragments of the calcareous tube of this species are met with in the Red as well as in the Coralline Crag; and I have found the valves imbedded in the globular masses of coral so abundant in the latter Formation, and also in the thickest part of the common oyster. These excavations made by the animal appear all to have been lined with a calcareous coating, as well in the thick shell of the oyster as in the porous substance of the coral; and the exterior of this marsupium, or purse-like envelope, is always more or less granular, wherever it is exposed. My specimens present considerable variation in regard to magnitude, some of the valves having twice the length of others, though all appear to have formed a calcareous lining to their excavation, and as such, it is presumed, they have attained to full maturity. I have none so small as to be considered the young, without the lining, assuming it *not* to have the power of increase after it has once formed its own envelope.*

This calcareous flask-like covering is terminated posteriorly with a tube for the protection of the siphons, which project a little beyond the surface of the coral, and the neck of this is often of considerable thickness. At a distance of about a quarter, or sometimes half an inch within the tube, a calcareous partition is seen (fig. 11 d), with a linear opening crossed in two places, assuming the form of a double dagger, each siphonal aperture having the appearance of a cross. This opening appears to be variable in different species, but whether the form be a good specific distinction I am not able to say.

* In the case of the *Gastrochæna*, it is probable that only when it has attained to full maturity does it form a lining to its crypt, or a covering to itself; this being, as it were, exterior and detached from the vital portions of the animal, may be incapable of alteration, but it probably possesses the power of dissolving or destroying this case, and constructing another, as occasions require, by the same means it has employed for the enlargement of its domicile. The prevailing opinion is, that the shell, or exo-skeleton, as it is called, being extra-vascular, is not susceptible of alteration by interstitial increase, but we know that absorption does take place; and the examination of shell-structure by the microscopist shows us clearly its highly organized condition, permeated with vessels for the conveyance of fluids; and it is exceedingly difficult to explain in any other way some of the operations of the Mollusca, more especially the alterations in magnitude of the hinges of the Bivalves, for example, during the growth of the animal.

In some specimens, the terminal tube projects a little distance beyond the surface of the coral, and of course, when alive, has its siphons always free. Occasionally the coral has either grown faster than the mollusc, or, what is more probable, had continued to increase after the death of the imprisoned animal, the terminal opening having been closed up by the growth of the coral.

PHOLAS,* *Linnaeus*.

DACTYLUS. *Pliny*.

HYPOGÆA HYPOGEODERMA. *Poli*, 1791.

ZIRFÆA. *Leach*, MS. 1817. *Gray*, 1851.

THOVANA. *Id.* 1818.

BARNIA. *Leach*, MS. 1819.

DACTYLINA. *Gray*, 1847.

ANCHOMASA. *Leach*, MS. 1819.

Generic Character. Shell ovate or transversely elongate, equivalved, inequilateral, externally rough or imbricated, more or less ornamented with radiating ridges, generally gaping at both extremities, occasionally furnished with accessory valves, and a reflected callosity over or before the beaks; a large, curved, testaceous appendage projects immediately beneath the umbo; no teeth or hinge ligament; and the impression of the mantle is deeply sinuated.

Animal thick and club-shaped; lobes of the mantle open in front, and reflected dorsally, by which the accessory valves are formed; siphonal tube long and extensile, divided at the extremity, and bordered with cirrhi; foot thick and truncated.

This is, generally speaking, a marine genus, and most of the species are inhabitants of shallow water, ranging to about 25 fathoms. *Ph. rivicola*, Reeves and Adams, 'Voyage of the Samarang,' pl. 25, fig. 5, is said to have been found burrowing in floating logs at Gunung Taboor, on the Pantai River, twelve miles from the sea, and where the water was quite fresh. This species is divided by a depressed line or sulcus, like *Ph. crispata*, and has, at the pedal opening, a calcareous covering, but without an accessory cup at the base of the siphons.

It is extremely difficult to define the generic limits of this group of shells. Some are furnished with an umbonal shield, consisting of several pieces; some have only a single dorsal valve, while in others this appendage is rudimentary or absent. These differences are considered to be only of specific value with many naturalists, while others make them generic distinctions.

The name given implies that the habits of these animals are those of excavators, and they are found to burrow in various materials, sandstone as well as calcareous rocks, wood, &c. The species do not always confine themselves to one kind for their habitations, and in all probability the mechanical mode is the one most generally

* Etym. *φωλεω*, to burrow, or hide in a hole.

employed; but whether the shell is the instrument used for such a purpose is not so satisfactorily determined. We sometimes find specimens with the asperities of the shell worn down, where the animal has located itself in mud; and at other times specimens have never had their roughened surfaces at all abraded. We know also that other animals than those belonging to the Mollusca, such as have no rough or hardened exterior, are able to penetrate deeply into stone as well as into wood.

1. PHOLAS CYLINDRICA, *J. Sowerby*. Tab. XXX, fig. 8, *a—d*.

PHOLAS CYLINDRICA. *J. Sow.* Min. Conch., t. 198.

— — *Nyst.* Coq. Foss. de Belg., p. 41, 1844.

Dale. Hist. and Antiq. of Harwich, p. 295, t. 13, fig. 6, 1730.

Spec. Char. *Testá elongatá, subcylindricá, tenui, fragili, valdè inæquilaterali; latere antico abbreviato, postico porrecto, acuminato; costatá, costis anticis dentato-muricatis, costis posticis ad extremitatis evanescentibus.*

Shell elongate, subcylindrical, thin, and fragile, very inequilateral; anterior side short, posterior prolonged, and obtusely pointed; costated; ribs on the anterior side toothed and rough, and on the posterior obsolete towards the extremity.

Length, 3 inches. *Height*, 1 inch, nearly.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton and Walton Naze.

This species is very abundant at Walton-on-the-Naze, but, from its fragility, specimens are difficult to obtain in perfect condition. In the Coralline Crag I have met with only a few fragments.

It most nearly resembles the British species, *P. parva*, from which it may, however, be distinguished by its being more inequilateral, the siphonal side occupying at least two thirds of the entire shell, and the opening for the foot on the ventral portion of the anterior side is larger and deeper. The shell is reflected over the back, covering the umbones, but the reflected portion is not partitioned like that of *Ph. dactylus*, and there is a tubercle at the middle, flattened by the pressure of the valves; the large and subovate impression of the adductor muscle is placed about midway between the umbo and the posterior extremity, and the line of the mantle-mark extends inwards a little beyond it; the plate or tooth curves from immediately beneath the beak, and is slightly spatulate in form. There is a small opening in the dorsal portion of the anterior side, which was no doubt covered by an accessory piece. Fragments of such a valve have been found by myself at Walton, most probably belonging to this species, (fig. 8, *d*.)

The figure given by Dale, above referred to, is no doubt our shell, as he says Dr. Woodward found it in Harwich Cliff; and as it is abundant at Walton Naze, its

proximity to that locality would fairly justify its being so considered, though he refers to Lister's figure, No. 276, which is *Ph. dactylus*, not as yet found in the Crag that I am aware of.

Pieces of indurated clay are occasionally met with at Walton Naze that have been perforated by this species; and I have a small portion, little more than two inches square, and half an inch thick, full of small specimens. These shells had effected an entrance from both sides, meeting in the middle; and one side contains almost as many as the other, showing the probability of the stone having been moved by the action of the water, to have permitted an ingress at both surfaces. A specimen of wood in my possession, from the Red Crag, but now in a lapideous state, contains an individual of this species, which, like *Ph. parva*, its very near relative, did not appear to confine itself to one kind of habitation. Some of these shells were at times only half immersed, as specimens have often the upper portion covered by the remains of a *membranipora*.

2. PHOLAS CRISPATA, *Linnæus*. Tab. XXX, fig. 9, *a—c*.

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| PHOLAS CRISPATA. | <i>Linn.</i> | Syst. Nat., p. 1111, No. 25, 1767. |
| — | <i>Penn.</i> | Brit. Zool., 1st ed. p. 77, pl. 40, fig. 12, 1776. |
| — | <i>Don.</i> | Brit. Shells, vol. ii, t. 62, 1801. |
| — | <i>Gould.</i> | Inv. of Massach., p. 27, 1841. |
| — | <i>Dekay.</i> | Hist. New York Moll., p. 247, pl. 32, figs. 506, and 506 <i>a</i> . |
| — | <i>Cuvier.</i> | Règne Anim., pl. 113, fig. 3, animal. |
| — BISFRONS. | <i>Da Costa.</i> | Brit. Conch., p. 243, t. 16, fig. 4, 4. |
| — PARVA. | <i>Id.</i> | Brit. Conch., p. 247. |
| — | <i>Donovan.</i> | Brit. Shells, vol. ii, pl. 69, 1801. |
| — LATUS. | <i>List.</i> | Hist. Conch., lib. iii, fig. 379 A, with the animal, 1685. |
| SOLENI CRISPUS. | <i>Gmel.</i> | Syst. Nat., p. 3228. |
| ZIRFÆA CRISPATA. | <i>Gray.</i> | List Brit. Moll., p. 53, 1851. |

Spec. Char. Testá ovatá, crassá, subæquilaterali, anticè breviorē, rostratá, et costatá; costis dentato-muricatis, latere postico rotundato; extremitatis hiantissimis; sulco unico submediano, obliquo.

Shell ovate, thick, slightly inequilateral, anterior side the shorter, beaked and ribbed; ribs furnished with roughened and prominent denticulations; extremities widely gaping: divided by a submedial oblique suture.

Length, 3 inches. *Height*, $1\frac{1}{2}$ inch.

Locality. Cor. Crag, Sutton.

Red Crag, Sutton, Walton Naze.

Mam. Crag, Bridlington.

Fossil, Sweden.

Recent, Britain, Scandinavia, and N. E. Coast of America.

Although essentially a boreal species, it lived in the seas of the Coralline Crag, a

fragment of a specimen having been there found by myself. It seems to have become much more abundant in the succeeding Period, as it is by no means rare at Walton Naze, but difficult to procure, the shells generally separating at the suture. It has also been found in the Drift Beds in Ireland, and ranges, in the living state, on the N. E. Coast of America, as far as South Carolina. The characters of this species are well marked, so as not easily to be confounded with any other. It is found in a very modern Tertiary Deposit at Bracklesham, where specimens have been obtained measuring $4\frac{1}{2}$ inches in length, in company with *Ph. candida*.

Ph. dactylus is in Mr. Smith's 'List of Clyde Fossils.'

PHOLADIDEA, *Leach*, 1819.

PHOLAS. *Turton*.

MARTESIA. *Leach*, 1818. *Blainv.* 1824.

JOUANNETIA? *Desmoul.* 1828.

PHOLIDEA. *Swains.* 1835.

Generic Character. Shell ovate or oblong, equivalve, inequilateral, externally rough or imbricated. Anterior extremity open in the young, but closed in the adult shell. Posterior extremity truncated and gaping, furnished with a coriaceous or testaceous cup when full grown.

Animal club-shaped; mantle closed, except a small opening in front for the passage of a truncated, sucker-shaped foot. Siphonal tube long, terminating in a disk, surrounded with cirrhi; terminal openings also fringed.

This genus has been founded upon a species of one of the rock-boring molluscs, whose great peculiarity is, that when it has arrived at the full stage of existence, it closes the previously large opening in front with a thin calcareous covering; and at its posterior termination there is added a small testaceous cup at the base of the siphons. If this be entitled to generic distinction it must rest its claim upon the latter character, as many of the *Pholades* have a large pedal opening in their young state for the active employment of that organ, possessing the same habits as the animal of this genus, in closing the aperture when full grown by a calcified membrane. Some other species also endowed with this habit, though not strictly according with the diagnosis of this genus, appear to be very closely related, viz., *Pholadopsis*, Conrad, and *Triumphalia*, Sowerby, but the valves are of unequal magnitude. Other species, possessing two radiating furrows, have been proposed for a genus by Conrad, under the name *Parapholas*.

The prolongation of the shell at the posterior side appears to be the commencement of what, in proximate genera, become a lengthened calcareous tube for the protection of the elongated siphons, as pointed out by Messrs. Forbes and Hanley, when con-

sidering this as the connecting link between the *Pholas* and the *Teredo*; and it may be further remarked, that the habit of closing its anterior opening, when the animal has attained to full maturity, is very analogous to the closing of the anterior portion of the tube in the adult or senile species in the *Teredo* and other tube-forming Bivalves.

Pholades have been found fossil as early as the Lias, and, as it might be supposed, were present in the Tertiary Formations. One species, in the Paris Basin, forms a calcareous lining to its burrow.

PHOLADIDEA PAPYRACEA, *Solander*. Tab. XXX, fig. 10.

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| PHOLAS PAPYRACEA. | <i>Solander</i> , MSS., fide <i>Turton</i> . Portland Cat., p. 82, lot 1828. |
| — — | <i>Turt.</i> Brit. Biv., p. 2, pl. 1, figs. 1—4, 1822. |
| — — | <i>G. Sow.</i> Gen. of Shells, No. 24, fig. 3. |
| — — | <i>Reeve.</i> Conch. Syst., pl. 24, fig. 3. |
| PHOLADIDEA GOODALLII. | Dict. des Sc. Nat., t. 37, p. 532. |
| — STRIATA. | <i>Cuv.</i> An. Kingd. (edit. Griffith), pl. 8, fig. 1. |
| — LAMELLATA. | <i>Turt.</i> Brit. Biv., p. 4, pl. 1, figs. 5, 6. |
| — LOSCOMBIANA. | <i>Goodall</i> in <i>Turt.</i> Conch. Dict., p. 147, 1819. |
| — PAPYRACEA. | <i>Forb.</i> and <i>Hanl.</i> Brit. Moll., vol. i, p. 123, pl. 5, figs. 3—6. |
| — — | <i>Gray.</i> List Brit. Moll., p. 52, 1851. |

Spec. Char. “*P. testá clavatá, latere antico clauso obtusissimo, postico hante truncato accessorio producto annulari.*”

“Shell club-shaped, closed and very obtuse at the anterior end, open and truncate at the other end, which is furnished with a produced accessorial ring.”—*Turton*.

Length, $1\frac{1}{2}$ inch. *Height*, $\frac{5}{8}$ inch.

Locality. Cor. Crag, Sutton.

Recent, South Coast of Britain.

A few fragments, in my cabinet, indicate so strong a resemblance to the recent British shell, that I do not hesitate to refer them to that species. One piece has the obtuse anterior extremity, with the smooth surface of the enclosed portion of the gape peculiar to the adult shell; while two fragments of the siphonal side are truncated, and marked with concentric lines like the recent species, without any radiating ridges. They are, however, unfit for description; and I have therefore copied the diagnosis from *Turton*.

TEREDO,* *Linnæus*, 1767.

TEREDO. *Sellius*, 1732. *Adamson*, 1757.

SIPHONIUM. *Brown*, 1756.

SERPULA (sp.) *Linn.* *Schröet.*

UPEROTUS (sp.) *Guettard*, 1774.

XYLOPHAGUS. *Gronov.* 1781.

TEREDARIUS. *Dumeril*, 1806.

SEPTARIA. *Lamk.* 1818.

XYLOTRYA. *Leach*, MS. 1817.

BANKIA. *Gray*, 1840.

MALLEOLUS. *Gray*, 1848.

* Etym. *τερηδων*, *Pliny*, a *τερηω*, to bore.

Generic Character. Shell convex, tumid, inequilateral, equivalved, presenting, with the valves united, an orbicular or nearly spherical outline, having a large angular opening in front, and a rounded or ovate aperture posteriorly; covered or ornamented externally with ridges or striae, caused by the slightly reflected or thickened edges of the margin; a testaceous process or tooth, of a somewhat spatulate form, curves and projects inwardly from beneath the umbo; one distinct muscular impression; ligament obsolete.

Animal worm-shaped; mantle open in front; siphons very long, bifurcating at their extremities; orifices fringed; foot rudimentary.

The valves are situated at the anterior extremity of an irregular, subcylindrical, elongated, and somewhat flexuous testaceous tube, which appears to be formed for the purpose of lining the cavity made by the animal. This tube, in some species, is large, thick, and heavy, while in others it is thin and semi-transparent; the variation, perhaps, depending upon a necessary protection against lateral pressure. At the posterior termination are two pennate or palmate opercula, called *pallettes* by Adanson, or *calamules* by Deshayes, by which the aperture is closed at the will of the animal, one probably employed as a lid to each siphon; and this end of the tube, in some species, is partitioned with segments or semi-camerations, but for what especial purpose has not been satisfactorily ascertained. The growth of the animal, and necessarily the enlargement of the valves, causes a corresponding increase in the size of the tube, which is lengthened at the anterior extremity, while the posterior part is kept on a level with, or a little beyond, the surface of the wood, so as always to keep the siphons free.* The addition of calcareous matter is made to the larger end only, which is kept open until the animal has attained to full maturity, when it is closed with a convex or dome-shaped termination.

The habits of most of the species lead them to excavate timber of all kinds. *T. corniformis* burrows in the husks of the cocoa-nut; and *T. arenaria* locates itself in mud. The tube of the latter animal (figured and described by Mr. Griffiths, in the 'Phil. Trans.' for 1806, p. 269, from a specimen found on the N. W. Coast of Sumatra) measured 5 feet 4 inches in length, and 9 inches at its greatest circumference; the posterior termination was longitudinally divided into two separate tubes for about 8 or 9 inches, and the larger end was closed, where the animal had constructed two separate septa a few inches within. The character of a longitudinal division for the two siphons is sometimes observable in the European species of this genus, and they terminate divergently; but this, probably, is not constant, and only dependent upon circumstances. The tube of *T. arenaria* presents, when fractured, a crystalline or radiating structure. The tubes of our fossil, and other European *Teredines*, are composed of numerous

* In the kindred genus *Xylophaga*, the animal does not furnish itself with a calcareous tube, as it never retreats far from the surface of the wood into which it has penetrated, consequently has no elongated siphons.

concentric layers, thickened with the age of the animal. *If* the Sumatra species correspond in all other respects with this genus, it will slightly diminish the value we have hitherto placed upon structural composition.

This genus is found abundantly imbedded in the fossil wood of the London Clay, and the fruits or seed-vessels of Sheppey (*Nipadites*, Bowerbank) are sometimes perforated by these animals. The tubes are of various sizes, some of them much smaller than others, the larger ends of which are generally closed, and consequently presumed to have attained to the full period of individual existence. The closing of the larger end is an operation performed also by other genera, such as *Clavagella* and *Aspergillum*, which have a perforated termination, and the valves are fixed or soldered into the sides of the tubes. This fixing of the valves is only done when the animal constructs the roof to its dwelling, as, if fixed at an earlier period, they would appear at irregular distances; and I believe the valves of these genera, like those of *Teredo*, are loose and free while the animals are growing, and only imbedded in the walls of the tubes at the time they have closed or imprisoned themselves by the construction of their dome-shaped or perforated disk.

There is no true ligament in this genus for the union of the valves, but a powerful muscle forms a deep impression upon the shell at the exterior of the dorsal margin, and is the only hinge on which the valves are moved.

A species has been found in the Lias in dichotyledonous wood.

The natural history of this "calamitas navium," as it was called by Linnæus, is graphically given by the authors of the 'Hist. of Brit. Moll.,' with the various opinions respecting these wood-eating animals, and their allies, the stone-eating *Pholades*. This subject is far from being exhausted, differences of opinion as to the *modus operandi* exist at the present day, and have done so ever since the time of Pliny, who imagined the animal of the *Teredo* to be a worm, and its two valves the formidable jaws by which it was capable of inflicting upon mankind such dire calamity. The species are not numerous, even in the recent state, but the individuals have multiplied to an alarming extent, and at one time threatened to submerge the States of Holland.

TEREDO NORVAGICA, *Spengler*. Tab. XXX, 12, *a—d*.

- TEREDO NORVAGICUS. *Spengler*. Skrivt. af Naturh. selsk., vol. ii, part 1, p. 102, pl. 2, figs. 4—6 B, 1792.
- NORVAGICA. *Lovén*. Ind. Moll. Scand., p. 50, 1846.
- — *Forb. and Hanl.* Hist. Brit. Moll., vol. i, p. 67, pl. 1, figs. 1—5, 1848.
- NORVEGICA. *Thompson*. Ann. and Mag. Nat. Hist., vol. xx, pp. 157, 163.
- — *Adanson*. Acad. Scien. Par., t. 9, figs. 1—8.
- NAVALIS. *Mont.* Test. Brit., p. 527; and Supp., p. 7.

TEREDO NAVALIS. *G. Johnston.* Mag. Nat. Hist., vol. ii, p. 23, fig. 7, *b*, 1829.

— — *Dekay.* Nat. Hist. New York, p. 34, fig. 325.

— BRUGUIERI. *Delle Chiaje.* Mem., vol. iv, pl. 54, figs. 9—12.

— — *Phil.* En. Moll. Sic., vol. i, p. 2; and vol. ii, p. 3.*

Spec. Char. Testá tumidá, convexá; angularibus striatis; utraque hiantē, hiato postico magno angulato; antico ovato.

Shell tumid, convex, subspherical; marked externally with angular striæ; gaping widely on both sides; posterior with a large angular opening; anterior ovate.

Diameter, $\frac{1}{2}$ inch.

Locality. Cor. Crag, Sutton, Ramsholt.

Red Crag, Sutton.

Recent, Norway, North America, Britain,
Mediterranean, and Black Sea.

A single valve, in my cabinet, is all that I have seen from the Crag, and this I believe to be *navalis* of Mont. Fig. 12, *c*, represents a fragment of the posterior portion of the tube, probably of this species, showing the camerated structure; but there is no appearance of longitudinal division. It is, however, too imperfect for any safe reliance in that respect.* Fragments of tubes are not unfrequently met with in the Red, as well as in the Coralline Crag, perhaps belonging to the same animal. They are thick and strong, with a diameter varying from $\frac{1}{8}$ th to $\frac{1}{4}$ th of an inch.

The valves of the different species of this genus preserve a great similarity, and it is said they can only be determined specifically by the pallets or styles at the posterior orifice, and as these have not, that I am aware of, been found in the Crag, the present appropriation, if the above be true, may be considered doubtful.

This portion of the Monograph contains the descriptions of forty-six species of Bivalves from the Lower or Coralline Crag Formation. Of this number, there are thirty-two identical with forms still in existence. From the Red Crag are described thirty-nine, out of which I have considered twenty-five as living species. Hence it will be seen that the former gives an amount of identification as high as 69 per cent., with a consequent extinction of 31; while the latter (Red Crag) has an amount of extinction as high as 36 per cent., giving, by this estimation, a greater antiquity to the higher or newer of the two Formations; and even presuming a better examination might bring the Red Crag on to an equality with the Coralline, the two Formations do not appear by this test to be capable of separation.

May it not be asked whether it is necessary, in order to ascertain the age of a Tertiary Formation by the per centage system, and to assign it to one of the tripartite or quadrupartite divisions of the Cainozoic series, we are to take the *whole* of the

* This part of the tube, according to Montague, affords little or no assistance in the determination of the species; the number of these camerations or partitions vary from four to as many as twenty; indeed, in one specimen he examined, he counted not less than twenty-nine.

Marine Fauna of the entire deposit, or may we be permitted to select a *part* only for such examination, and if so, what part?

The Mollusca herein described bear so close a resemblance to animals now living in our own seas, as to give good reason to believe their geological relationship to be *much* nearer to the present Period than to the Eocene; and if an amount of extinction of *more* than one half of its species be necessary to entitle a Deposit to be considered as belonging to what is called the Miocene or Middle Tertiary, our present identifications do not fulfil those required conditions, even for the lowest or oldest (by position) of the Crag Formations.

Assuming that a different construction might be put upon a few of the specific determinations, in opposition to the conclusions I have arrived at, I much doubt whether the Coralline Crag could possibly be made to contain more than 50 per cent. of extinct species of Mollusca; while the connection zoologically between this Deposit and those of the Eocene is so small as to have an identity of *less* than 1 per cent. that have transmitted their posterity *unaltered* from those Periods into the Crag; and although a considerable difference of conditions probably existed under which the Formations were deposited, Tropical forms are by no means wholly excluded from the Coralline Crag Sea, neither are sub-Arctic genera, such as *Glycimeris*, *Astarte*, and *Cyprina*, absent from the Older Tertiaries.

When the present work was begun, I had purposed to call it simply 'A Monograph of the Crag Mollusca;' but this title had to be submitted to the Council of the Palæontographical Society for their approval, when the term "Crag" was thought by some of the members of that body to be of too local or technical a significance, and would not be fully understood by foreign geologists; and the explanatory addition of 'Descriptions of Shells from the Middle and Upper Tertiaries of England' was then suggested, and acceded to by myself.

A more complete examination of these Deposits, during the progress of the work, has induced me to believe the term "Middle" to have been incorrectly introduced, there being no remains of a Formation in Great Britain referable to that Period, more especially if we are to depend, for such determination, upon the amount of extinction by the per centage mode of valuation; it is therefore requested to erase the words Middle and Miocene from the title-pages and other parts of the work formerly given, as I believe the Formations I have been here attempting to illustrate belong with more propriety to the Upper Tertiaries.

APPENDIX.

CEPHALOPODA.

SINCE the publication of the first part of this work, the Red Crag "diggings" have turned up portions and segments of *Nautilus* and *Ammonites*, but these, like the *Belemnites*, are derivative fossils, and may be traced to antecedent Formations; the *Nautilus* apparently to the London Clay, and the *Ammonites* to one of the middle Secondary Periods.* The Cephalopods living in our own seas, and even in those of more southern latitudes, like the Mediterranean, in association with a Marine Fauna similar to that of the Coralline Crag, are of such a perishable nature, and possess so little of preservable material, that, except under very favorable protection, should we be likely to find any portion of their remains. What are called the Tetrabranchiata, with strong calcareous shells, such as those from the Middle Tertiaries of Bordeaux and Dax, do not appear to have extended their existence into the sea of the Coralline Crag, although the *Pyrula* and *Pholadomya* (tropical forms), when first obtained in the Deposit of that Period, gave a slight hope that the *Nautilus* might also there be met with.†

* In my cabinet are casts also of several species of Univalves and Bivalves, which, so far as such fossils will permit of an identification, are of shells belonging to the Older Tertiaries; and I will here mention that, although a few of the extraneous organic remains of the Red Crag may be traced to the Chalk and Older Secondaries, the great majority I believe to have been derived from the Eocene Deposits, and principally from the London Clay proper, along with the phosphatic nodules; and I would assign to the same source (the Older Tertiaries) the marine Vertebrata, *Carcharodon*, *Lamna*, *Myliobates*, *Pycnodus*, *Phyllodus*, *Edaphodon* *Pristis*, &c. &c., as well as the Cetacea, recently found in such abundance, and the Crustacea (*Zanthopsis*, &c.),—the abrasion, by coast action, being, in my opinion, sufficient to produce all the effects now visible in the Red Crag, with the sea of that period opening to the northward. Christchurch Bay, between Handfast Point and the Needles, may perhaps furnish us with a parallel.

† In the second part of the 'Eocene Mollusca,' by F. E. Edwards, Esq., is an address to the subscribers of the Palæontographical Society, respecting the Siphuncular Theory of the Cephalopoda. The author, when treating of the tube which perforates the chambers of the shells in that class of animals, attributed to myself the priority of pointing out a new explanation of the function of that organ, one which seems now to be generally admitted, and published in his own and better language the statement I had given him of my opinion, and the arguments used in support of it. This priority has, it seems, been laid claim to in the sentence quoted in that address. I have, until now, remained silent upon the subject, and would gladly have continued to do so, had not some of my friends expressed a desire that I should defend myself from what, to them, appears to be capable of being interpreted into an appropriation of the discovery of another as my own idea. The only defence that can now be offered is, that I was wholly unconscious of any other function than that of a hydrostatic balance having ever been attributed to this tube, and I confess to my having been unacquainted with the paragraph referred to.

The necessity of maintaining an integrity of character, and the preservation or permanence of adhesion in the inorganic elements in these Cephalopods, occurred to me from the especial study of *Bulimus decol-*

GASTEROPODA.

The following land and fresh-water shells are from the Formations belonging to the Uppermost or Newest Tertiaries of Great Britain. These shells are all, with the exception of four, undoubtedly identical with species still in existence in England, and it is thought an insertion of their names alone, with a reference to where they have been recently well figured and described, will be sufficient. The exceptions, though here extinct, are still existing in other parts of Europe; and as they were formerly inhabitants of where their remains are now found, they claim a place in the Monograph of the Upper Tertiaries of the British Isles.

I am indebted to Mr. John Brown, of Stanway, for the list of species from Copford and from Fisherton.

latus and other decollated, or rather decapitated, shells, which appeared to have become so from the want of the necessary connection between the shell and the more vital parts. It is to Dr. Fleming, perhaps, that the real priority of the idea should be awarded. In his 'Philosophy of Zoology' there is a very significant passage, where he speaks of the *vitality* of the shell when in intimate contact with the fluids of the animal, foreshadowing there the belief, now generally entertained, that the calcareous portions of the Mollusca are far from being inert matter, secreted merely as protective coverings to the softer parts (a considerable section being wholly destitute of such coverings), but that they are truly constituent and integral portions of the animals themselves, only with a larger amount of inorganic elements.

It is well known that, in some of the extinct species of Cephalopods, the tube is protected throughout its entire length by a rigid, continuous, and inflexible covering, and one can scarcely refrain from an expression of astonishment that naturalists, who have purposely studied, and largely published their views upon the *Nautilus* and its congeners, should not have discerned the now presumed use of the siphuncle. If seen, it is perhaps still more extraordinary that this *silver cord* should have had with it so little explanation.

My friend Mr. Edwards has (I think wisely) left the determination of the claim to priority to the judgment of the members; but an ulterior question arises, which is, whether the paragraph quoted by Mr. Edwards in his address amounts to more than the suggestive passage by Dr. Fleming, similar in its purport, to which I have referred.

The two passages are here subjoined:—

"The shell cannot be considered as dead matter so long as it remains in connection with the living animal. In those animals in which the shell is external, there are muscles which connect the animal with its external surface, and the bond of union being a substance soluble in water, the muscles can be detached by maceration. The analogy between shell and bone is here obvious, although in the one case the connection between the muscle and the bone is permanent, in the other between the muscle and the shell temporary, or frequently changed during the life of the animal. But the *vitality* of the shell, if I may use the expression, is demonstrated from the changes which it undergoes when detached from the animal. The plates of animal matter harden, the epidermis dries, cracks, and falls off, and in many cases the colours fade or disappear. We confess ourselves unable to point out the means employed by the animal to prevent these changes from taking place by any process similar to circulation."—*Phil. of Zool.*, by Dr. Fleming, vol. ii, p. 405, 1822.

"Whatever additional advantage the existing *Nautilus* might derive by the continuation of a vascular, organized membranous siphon through the air-chambers, in relation to the maintenance of vital harmony between the soft and testaceous parts, such likewise must have been enjoyed by the numerous extinct species of the Tetrabranchiate Cephalopods, which, like the *Nautilus*, were lodged in chambered and siphoniferous shells."—*Lectures upon the Invertebrata*, by Professor Owen, p. 331, 1843.

Mr. Pickering has furnished me with those from Grays and the Kennet Valley; Mr. Woodward has supplied the Maidstone one; and the Cropthorn list was published by the late Mr. Strickland. The species from Clacton and Stutton were obtained by myself, and for which I am responsible.

Land or fresh-water shells have also been found at Bacton (*a*), Brentford, Cambridge (*b*), Casewick, Charing (*b*), Chislet, Clapton, Cuxton (*b*), near Stroud, Erith, Faversham, Folkestone, West Hackney, Harwich, Hemingford Abbots, Herne Bay, Ilford, Isle of Wight, Littleport (*b*), (Isle of Ely), Market Weighton, Mundesley, Peterborough, Rain near Braintree, Runton, Stamford, Valley of the Nar (*b*), Witham, and Yeovil; perhaps elsewhere, but the localities are too numerous to have here a separate and distinctive catalogue. (*c*) These Lacustrine or Fluvatile Beds appear to be principally confined to the middle and southern portions of England; and although they may, perhaps, exist in Scotland or in Ireland, I have been unable to procure, for insertion here, the name of any locality that might be considered as analogous or synchronous with the older of these deposits. The fresh-water fossils that have come under my observation from either of those kingdoms, or from the Isle of Man, were found in peat bogs.

By the following table it will be seen that the species of fresh-water shells fall short of those which live exclusively on land, although the individuals of the former generally outnumber those of the latter, as we see amongst the same group of Mollusca of the present day. In the Uppermost Tertiaries we have about fifty-five species of land shells, with about forty-four fresh-water ones. In the latter are included eleven species of Bivalves, and the amphibious Succinea. Our catalogues of the land and fresh-water Mollusca existing in England enumerate about seventy-two of the former, with fifty-one of the latter, giving a slight difference in the proportions between the recent and fossil species; but the excess in number at the present day is greater than can be made up by the extinct species of these deposits, showing that, if we really have obtained *all* the species belonging to those past periods, the incomers exceed those which have here gone out of existence, giving a considerable increase to the existing Fauna, making the insular condition of England better tenanted than when it is supposed to have formed a part of the Continent.

(*a*) Bacton is considered by Mr. Prestwich (from position) to be the oldest of all these fresh-water deposits; it is most probably synchronous with the Marine and Estuary Beds of Chillesford and Bramerton. I much regret my list of Mollusca from this locality is so insignificant as to be unworthy of a separate insertion. Chislet, Ilford, and Mundesley contain one or more of the extinct species, and these may be assigned to the age of Stutton, Grays, &c.

(*b*) These are probably the most modern.

(*c*) The uppermost Tertiaries, or those above the Crag in these islands, have, with every degree of probability, been separated into four distinct Geological Periods, and our able coadjutor, Mr. Prestwich, has, I believe, come to the conclusion that an addition must even be made to this number. Their separation has, however, been founded exclusively upon geological evidence; and it is with the hope that palæontological aid may afford some slight assistance to their correct determination that I have made a separate enumeration of the contents of several of our most important fresh-water localities. Existing species certainly extend through all, but they are not equally disseminated.

The want of permanence presented by the more recent Formations in the duration of the specific existence of their Fauna, compared with those of more ancient Deposits, is probably owing to the greater variety and more rapid alterations of the conditions under which the organisms have their existence in recent epochs than in those more remote.

(a) A fragment of what appears to be this species is in my cabinet, and the name is also in Mr. Trimmer's Paper on the Orton Gravel.—*Quart. Journ. Geol. Soc.*, vol. x, p. 346.

(b) A fragment, on the authority of Mr. Pickering.

(c) In Mr. Brown's List.

(d) Professor Morris, in his 'Catalogue,' gives this from Clacton. May not the burrowing habits of the living animal have introduced it amongst the fossils? I have frequently found dead specimens when examining the Cor. Crag sand.

(e) I have been unable to obtain any satisfactory evidence of the fossil state of this species. An imperfect *Clausilia* much resembles it, and may possibly have been mistaken as such.

(f) From the Valley of the Nar. (*C. B. Rose*.)

(g) My cabinet contains only a fragment, from Clacton, of what may be this species.

(h) This is given with a ?, in Mr. Prestwich's Paper, *Quart. Journ. Geol. Soc.*, vol. xi, p. 110, *loc.* Shacklewell Lane. It is mentioned also in Mr. Trimmer's Paper on the Orton Gravel, *loc. cit. ante*.

(i) From Sir Charles Lyell's Paper on the Mundesley Fresh-water Beds.—*Phil. Mag.*, vol. xvi, p. 365.

(k) The fragment of a *Physa*, from Clacton, is in my cabinet, but not perfect enough to determine the species.

(l) *Pl. levis* is mentioned in Sir Charles Lyell's Paper from Mundesley. I presume it is this species.

| No. of Species. | PULMONATA. | | | | | | Stutton. | Clacton. | Grays. | Crofton. | Coptford. | Fisherton. | Maidstone. | Newbury. |
|--------------------|---|--|--|--|--|--|----------|----------|--------|----------|-----------|------------|------------|----------|
| | | | | | | | | | | | | | | |
| | Planorbis nautilus, <i>Linnaeus</i> , v. Hist. Brit. Moll., | vol. iv, p. 152, pl. 126, figs. 6, 7 | | | | | * | * | * | * | * | * | * | * |
| 75 | — nitidus, <i>Müller</i> | „ vol. iv, p. 161, pl. 127, figs. 11, 12 | | | | | * | * | * | * | * | * | * | * |
| | — marginatus, <i>Draparnaud</i> | „ vol. iv, p. 155, pl. 127, figs. 1-3 | | | | | * | * | * | * | * | * | * | * |
| | — carinatus, <i>Müller</i> | „ vol. iv, p. 152, pl. 127, figs. 4, 5 | | | | | * | * | * | * | * | * | * | * |
| | — lacustris, <i>Lightfoot</i> | „ vol. iv, p. 162, pl. 128, figs. 1-3 | | | | | * | * | * | * | * | * | * | * |
| | Cyclostoma elegans(a), <i>Müller</i> | „ vol. iv, p. 201, pl. 122, fig. 3 | | | | | * | * | * | * | * | * | * | * |
| 80 | Acicula lineata, <i>Draparnaud</i> | „ vol. iv, p. 204, pl. 125, fig. 7 | | | | | * | * | * | * | * | * | * | * |
| | — — <i>Id.</i> var. perversa „ | „ „ „ „ „ „ „ | | | | | * | * | * | * | * | * | * | * |
| PECTINIBRANCHIATA. | | | | | | | | | | | | | | |
| | Neritina fluviatilis, <i>Linnaeus</i> , v. Hist. Brit. Moll., | vol. iii, p. 3, pl. 71, figs. 1, 2 | | | | | * | * | * | * | * | * | * | * |
| | Paludina vivipara(b), <i>Id.</i> | „ vol. iii, p. 11, pl. 71, figs. 14, 15 | | | | | * | * | * | * | * | * | * | * |
| | — marginata, <i>Michaud</i> , vide p. 320 | „ „ „ „ „ „ „ | | | | | * | * | * | * | * | * | * | * |
| | Bithinia tentaculata, <i>Linnaeus</i> , v. Hist. Brit. Moll., | vol. iii, p. 14, pl. 71, figs. 5, 6 | | | | | * | * | * | * | * | * | * | * |
| 85 | — ventricosa, <i>Gray</i> | „ vol. iii, p. 16, pl. 71, figs. 7, 8 | | | | | * | * | * | * | * | * | * | * |
| | Rissoa Thermalis? <i>Linnaeus</i> , vide p. 319 | „ „ „ „ „ „ „ | | | | | * | * | * | * | * | * | * | * |
| | Valvata piscinalis, <i>Müller</i> , v. Hist. Brit. Moll., | vol. iii, p. 19, pl. 71, figs. 9, 10 | | | | | * | * | * | * | * | * | * | * |
| | — — <i>Id.</i> var. antiqua, <i>Morris</i> „ | „ „ „ „ „ „ „ | | | | | * | * | * | * | * | * | * | * |
| 88 | — cristata, <i>Müller</i> | „ vol. iii, p. 21, pl. 71, figs. 11-13 | | | | | * | * | * | * | * | * | * | * |

(a) Specimens of this species, with *H. ericetorum* and other land shells, are found at Bostol, near Woolwich, in a deposit of several feet in thickness (8—10), probably a talus from the chalk. A similar bed, containing numerous species of land shells, is mentioned as resting upon the Greensand at Gore Cliff. (*Bowerbank*, 'Proc. Geol. Soc.', vol. ii, p. 449.) I have met with this species (*C. elegans*) in like situations over the Crag, though I have never seen it in a living state in the eastern part of Suffolk. Mr. Woodward gives it from the Caves of Torquay.

(b) This is given in Sir Charles Lyell's Paper on the Mundesley and Runton Beds, *loc. cit. ante*.

HELIX FRUTICUM, *Müller*. Tab. XXXI, fig. 19, a, b.

HELIX FRUTICUM. *Müll.* Verm. Terr. et Fluv. Hist., p. 71, No. 267, 1773.

— — *Schröter*. Erdconch., p. 178, t. 2, fig. 19, Nos. 55—59, 1771.

— — *Chemn.* Conch. Cab., vol. ix, p. 150, t. 133, fig. 1203, 1786.

— — *Drap.* Hist. Nat. des Moll. Ter. de la France, p. 83, No. 10, pl. 5, figs. 16, 17, 1805.

— — *Brard.* Hist. des Moll., p. 58, No. 14, pl. 2, fig. 13, 1815.

— — *Pfeff.* Deutsch Land und Sussw. Moll., p. 23, No. 3, pl. 2, figs. 3—5, 1821.

— — *Rössmasl.* Icon. der Lund. und Sussw. Moll., p. 61, pl. 1, fig. 8.

— CINEREA. *Poiret.* Prodr., p. 73, No. 8. Fide *Deshayes*.

— TERRESTRIS? *Gmel.* ex *Drap.*

Spec. Char. "Testá orbiculato-convexa, umbilicatá, tenui, pellucidá, obsoletè-striatá, albidá; spirá subprominulá, labro margine reflexo."

Shell roundedly convex, umbilicate, thin, pellucid, obsoletely striated, white; spire slightly prominent; outer lip reflexed.

Diameter, $\frac{3}{4}$ inch.

Locality. Fossil, Stutton.

Recent, Denmark, France dans la Bresse (Depart. de l'Aisne), Salève near Geneva (*Jeffreys*).

One specimen only of this species, obtained by myself, is all that I have seen. It appears to be full grown, though its sharp and reflexed outer lip is destroyed, but in all its other characters it perfectly resembles the recent shell.

HELIX INCARNATA? Müller. Tab. XXXI, fig. 17, *a*, *b*.

| | | |
|------------------|-------|--|
| HELIX INCARNATA. | Müll. | Loc. cit., p. 62, No. 259, 1773. |
| — | — | Drap. Loc. cit., p. 100, No. 29, pl. 6, fig. 30, 1805. |
| — | — | Pfeffer. Deutsch Land und Sussw. Moll., p. 33, pl. 2, fig. 15, 1821. |
| — | — | Rossm. Loc. cit., p. 35, t. 26, fig. 361. |
| — | — | Desh. Exped. de Morée, p. 160, No. 231. |
| — | — | Brown. Geol. Journ., vol. viii, p. 190, fig. 4, <i>a—c</i> , 1852. |

Spec. Char. “*Testâ subglobosâ, depressiusculâ, perforatâ, pellucidâ, corneâ; spirâ prominulâ; labro margine rufescente, subreflexo.*”

“Shell subglobosa, slightly depressed, perforated (umbilicated), pellucid, and corneous; spire slightly prominent; margin of lip reflexed and reddish.”

Diameter, $\frac{1}{2}$ inch.

Locality. Fossil, Copford.

Recent, France, and Belmont near Lausanne.

Two or three specimens only of what most probably belonged to this species are all that I have seen. They were obtained at Copford by Mr. John Brown, who has obligingly permitted me to have them described; they are unfortunately not in a very good state of preservation. The best specimen appears to correspond with the recent shell; but not being full grown, it has only five volutions instead of six, and is evidently an immature individual, consequently wants the reflexed lip, the character of maturity. It differs from *rufescens*, which is more depressed; and from *hispidâ* in having a smaller umbilicus; and our fossil is more globose than either. The identification is not, however, perfectly satisfactory, and it would be desirable to see a few more and better specimens.

HELIX RUDERATA, Studer. Tab. XXXI, fig. 15, *a*, *b*.

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|-----------------|---------------------------|---|
| HELIX RUDERATA. | Stud. | Systemat. Verz. der Schweiz. Conch. s. 86, 1820. |
| — | — | Hartman. Erd. et Sussw. Moll., No. 57, t. 11, fig. 11, 1821. |
| — | — | Pfeff. Deutsch Land und Sussw. Moll., p. 31, t. 4, fig. 26, 1824? |
| — | — | Rossm. Icon. Land and Sussw. Moll., p. 13, t. 32, fig. 455. |
| — | — | Brown. Geol. Journ., vol. viii, p. 190, fig. 4, <i>d</i> , <i>e</i> , 1852. |
| — | ROTUNDATA, var. β . | Nils. Hist. Moll. Suec. Terr. et Fluv., s. 31, 1822. |

Spec. Char. “*Testâ perspectivè-umbilicatâ, depressâ, lutescentè-cornea, concolor, subtilissimè costulato-striatâ, spirâ convexâ, anfractibus 4—5 subteretibus; aperturâ ovali; peristomate recto, simplici, acuto.*”
—Rössmasler.

“Shell perspectiveally umbilicated, depressed, of a clouded or dirty-horn colour, very finely striated by elevated lines of growth; spire convex, volutions 4—5, tapering; aperture ovate; peristome plain, simple, sharp.”

Diameter, $\frac{1}{4}$ inch.

Locality. Fossil, Clacton, Grays, Copford.

Recent, Sweden, Finland, Russia, Styria, Switzerland, and Cincinnati, U. S.

This is not very rare at Clacton; at Copford, Mr. Brown tells me, it is so. It closely resembles *H. rotundata* in its large umbilicus and elevated ridges, but is justly separated from that species by well-marked characters, having large volutions, which are fewer in number, and the aperture is consequently more open. *H. striatella*, Anthony, 'Bost. Journ. Nat. Hist.,' vol. iii, p. 278, pl. 3, fig. 2, an existing species in the United States, is now admitted to be the same as the above; and *H. perspectiva* is, perhaps, only a variety. A species, with a geographical range extending from Russia and Switzerland to Massachusetts and Ohio, might be expected to possess considerable variation.* In my List of Land and Fresh-water Shells from the Older Tertiaries, at Hordwell, published in the 'Lond. Geol. Journ.,' vol. i, p. 118, I had considered a species found there to have prolonged its existence *unchanged* to the present time, and that the one above referred to (*striatella*) was its specific descendant. Mr. F. Edwards, in his 'Monograph of the Eocene Moll. Pulmonata,' p. 66, gives his opinion adverse to that decision; and I am now inclined to think he is correct. *H. labyrinthica* was given in my list as one of the species existing at the present time, while two others were also inserted there, but with a doubt. I was at one time impressed with the idea that an air-breathing mollusc, being less exposed to a variation of conditions, was enabled to preserve a specific existence longer than its marine brethren; and I fear it gave a slight bias to my determinations. Mr. Edwards has bestowed upon the *labyrinthica* a very critical and a very able examination, and has pointed out some differences between the Hordwell fossil and the existing American shell; but they were not, he considered, sufficient to invalidate their identity, more especially as the living shell is itself subject to considerable variation; assuming, also, that if we possessed a large series of fossil specimens, these differences would probably disappear: is it really certain that the possession of a larger series must necessarily bring the recent and fossil nearer together? This species of mollusc appears to stand almost, if not entirely, by itself, as dating its existence from the Older Tertiaries; and, as we are obliged to depend exclusively upon the restricted characters of the shell alone, we are compelled to admit its identity, from the impossibility of pointing out a dissimilarity such as is generally considered sufficient for specific separation. Might it not be possible that the combined characters of the entire animal, could they be possessed, would exhibit a difference so as to prevent its coming within the definition of a species in the present acceptance of that term? If this Hordwell fossil be really still an existing shell, it militates somewhat against the hypothesis that a species with a very prolonged existence in regard to time, would, if still in being, have a more extended geographical range, and *vice versa*; it does not appear so in regard to *Helix*, when *labyrinthica* is compared with *rudrata*.

SIPHONOSTOMATA.

MITRA EBENUS, *Lamarck*. Tab. XXXI, fig. 7.

- | | | |
|---------------|------------------|--|
| MITRA EBENUS. | <i>Lam.</i> | Ann. du Mus., vol. xvii, p. 216, No. 58, 1822. |
| — — | <i>Phil.</i> | En. Moll. Sic., vol. i, p. 229, t. 12, figs. 8—10. |
| — — | <i>Bellardi.</i> | Monog. delle Mitre Foss. del Piedmonti, p. 23, t. 11, figs. 20—23, 1850. |
| — | PYRAMIDELLA. | <i>Bronn.</i> var. β . Ind. Palæonth., p. 733, 1848. |
| — | PLUMBEA. | <i>Lamk.</i> Hist. des An. s. Vert., tom. vii, No. 73, 1822. |

* This is the only one of the six extinct species belonging to these Fluvial deposits that has its range to the westward; the others belong to the European Continent, with the exception of *Cyrena consobrina*, now an inhabitant of the Nile. The Mollusca of these beds do not appear to have any connection with the peculiar, and probably more recent, Faunas of the Canaries, Madeiras, or the Azores.

- MITRA LÆVIS? *Dubois*. *Wolhyn. Pod.*, t. 1, figs. 2, 3. Fide *Phil.*
 — DEFRANCHII. *Payr.* *Cat. Moll. Cors.*, p. 166, t. 8, fig. 22.
 — CORNICULA. *Sismond.* *Syn. Meth. an. Invert. Ped. Foss.*, p. 41.
 VOLUTA PLICATULA. *Brocchi.* pp. 318 and 646, t. 4, fig. 7.
 — CORNICULA. *Linn.* *Syst. Nat.*, ed. 11, p. 1191.

Spec. Char. *Testâ turratâ, sublævigatâ, aut obsoletè costatâ; anfractibus convexiusculis; aperturâ spiram æquante; columellâ triplicatâ sive quadruplicatâ.*

Shell turreted, nearly smooth, with obsolete ribs; whorls slightly convex; aperture the length of the spire; columella with three or perhaps four folds.

Length. $\frac{3}{4}$ inch.

Locality. Cor. Crag, Gedgrave.

Recent, Mediterranean. Fossil, Apulia and Piedmont.

A single specimen of this genus has been obligingly presented to me by Mr. Charlesworth, and this is the only one I have seen. It is not quite perfect, the outer lip being slightly broken, but it is otherwise in good condition; and there is every reasonable probability of its belonging to one of the variable forms of *ebenus*. It most resembles the variety with the upper volutions somewhat obscurely costated, having the body one smooth. My specimen has seven volutions, and three distinct folds upon the columella; the upper two folds large and distant, the third smaller and closer, with a very minute one lower down, perhaps invisible if the lip were perfect. There is a slightly depressed mark around the upper part of the volution, and, in the living state, probably corresponded with Philippi's description, "infra suturas linea albida obscurè cinctis."

A specimen of *Mitra* is mentioned, in the 'Mem. of the Geol. Survey,' vol. i, p. 429, as having been found in the Glacial Beds of Wexford, and referred to *M. cornea*, Lamk., with doubt.

MITRA PLICIFERA. *S. Wood.* *Crag Moll.*, vol. i, p. 21, t. XXXI, fig. 8.

Not having been able to obtain anything more perfect than what have been so long in my cabinet, I have had my best specimen figured, in order to call attention to its existence in the Coralline Crag. It appears too strongly costated to be a variety of *ebenus*, and the apex is more obtuse than in that species. It must, therefore, remain for the present with its provisional name.

PYRULA ACCLINIS, *S. Wood.* Tab. XXXI, fig. 6, *a*, *b*.

PYRULA RETICULATA, *Lam., vide.* *Crag Moll.*, vol. i, p. 42, t. 2, fig. 12.

A better knowledge of the various recent shells of this genus give reason to believe the differences previously pointed out between the fossil and the recent species, to which it was assigned, are sufficient to entitle it to specific distinction; I therefore propose for the Crag shell the above name.

Edward Acton, Esq., of Grundisburgh, has, out of his rich collection, presented me with a cast in sandstone of what most probably was this species, obtained from the Red Crag of Sutton, which appears to present a still greater difference from the recent *reticulata* than do either of my own specimens, from which the assignment had previously been made. This cast (fig. 6, *a*) shows a greater elevation of spire than either the recent shell or my own fossils, which might perhaps be expected; but the excess in height is more than would arise simply from its being a cast, and it shows also more particularly that the shell from which it was taken had a shorter canal than the true *reticulata*: the latter character is, I think, sufficient to separate our fossil from the existing species, and I am the more readily induced on that account to change the name previously given.

This is in a sandstone nodule, similar to what has been spoken of at p. 69, and the cavity left by the withdrawal of the shell is imperfectly filled by carbonate of lime in a crystallized state, the crystals

being deposited upon the internal cast; while upon the matrix is exhibited the sculpture of the exterior on which also are deposited similar crystals. Besides the present species, Mr. Acton has kindly given me a specimen of *Nassa conglobata* in the same state; and although the last has not yet been found in the Coralline Crag, I think there is every reason to believe the cast of this species, as well as the other sandstone nodules previously noticed, are the littoral remains of a destroyed portion of what might have been a purely sandy deposit of the age of the Older Crag.

TROPHON NORVEGICUM, *Chemnitz*. Tab. XXXI, fig. 1, *a*, *b*.

STROMBUS NORVEGICUS. *Chemn. Conch. Cab.*, vol. x, p. 218, t. 157, figs. 1497, 1498, 1788.

FUSUS NORVEGICUS. *Turt. Mag. Nat. Hist.*, vol. vii, p. 351, 1834.

— NORVEGICUS. *Howse. Ann. and Mag. Nat. Hist.*, vol. xix, p. 162, pl. 10, figs. 1—4, 1847.

— — *Forb. and Hanl. Hist. Brit. Moll.*, vol. iii, p. 428, pl. 107 and 108, fig. 7.

TRITONIUM NORVEGICUM. *Midd. Malaco. Rossica.*, part 2, p. 147.

— — *Lovén. Ind. Moll. Scand.*, p. 11, 1846.

Spec. Char. “*T. oblongá, subulatá, albá, anfractibus sex teretibus; aperturá patulá ovatá, caudá subadscendente, fauce eburneá.*”—*Chemnitz*.

“Shell smooth, volutions six, rather flat, the lower one ventricose; aperture twice the length of the rest of the shell, and pure white; outer lip much dilated, and smooth on the inner margin; the edge sharp and slightly reflected; pillar smooth.”

Length of recent shell, $4\frac{1}{2}$ inches.

Locality. Red Crag, Sutton and Felixstow.

Recent, British and Arctic Seas.

A few fragments, or the young state of this species, have been for some time in my cabinet, but their very imperfect condition rendered an assignment doubtful; and until the discovery of the larger specimen, which was obtained at Felixstow by Mrs. Henry Bartlet, of Ipswich, who has obligingly entrusted it to my care for examination and representation, I was fearful to introduce the name into the List of British Fossils; but there is now very good reason to believe the above-named species was an inhabitant of our seas during the period the Red Crag was deposited. Mrs. Bartlet's specimen (fig. 1, *a*) consists of a considerable portion of the shell, with the outer lip and anterior canal destroyed: what remains corresponds so closely with the existing species, that there is every probability of its identity. Our shell is thin, has lost its outer coating, and the suture in consequence is deepened; upon the shell are still visible numerous, but somewhat obsolete striæ. The fracture of the specimen appears to have been produced or accelerated by the inroads of a *Cliona*—a means of destruction not uncommon with the shells of the Crag. Being unable to give a detailed description, I have taken the diagnosis from *Chemnitz*; he refers to ‘*Seba Thesaur.*’ vol. iii, t. 52, fig. 9? 1758, who was probably the first to notice the species. It is said to have been found in the Newer Tertiaries of Sweden.

Mr. Howse states having dredged the living shell, in sixty fathoms water, off the Durham coast.

TROPHON TURTONI, *Bean*. Tab. XXXI, fig. 2.

FUSUS TURTONI. *Bean. Mag. Nat. Hist.*, vol. vii, p. 493, fig. 61.

— — *Howse. Ann. Nat. Hist.*, vol. xix, p. 163, pl. 10, figs. 6—10.

— — *Reeve. Conch. Icon. Fusus*, vol. iv, pl. 20, fig. 83.

— — *Forbes and Hanley. Hist. Brit. Moll.*, vol. ii, p. 431, pl. 105, figs. 3, 4, and pl. 106, figs. 2—4.

Spec. Char. “*Testá ovato-turritá, crassiusculá; spirá enormiter acuminato-productá, apice papillari; anfractibus spiraliter striatis, supernè concavis, vix angulatis; aperturá amplá, labro incrassato subreflexo; albida.*”—Reeves.

“Shell ovately turreted, somewhat thick; spire enormously produced, with a mammillated apex; whorls spirally striated, concave on the upper part, scarcely angulated; aperture large, with a thickened, slightly reflexed outer lip.”

Length (of the recent shell), 5 inches.

Locality. Red Crag, Ramsholt.

Recent, British Seas.

The fragment of a shell in my cabinet corresponds with the young or spiral portion of the above-named recent species, and this is all that I have seen; it is thin and fragile, having lost its outer coating, and is quite smooth, and it is placed provisionally in this position.

TROPHON PROPINQUUM? *Alder.* Tab. XXXI, fig. 3, *a, b.*

FUSUS PROPINQUUS. *Alder.* Catal. Moll. Northum. and Durh., p. 63.

— — *Forb. and Hanl.* Hist. Brit. Moll., vol. iii, p. 419, pl. 103, fig. 2.

— SABINI. *Forbes.* Mem. Geol. Surv. Grt. Brit., vol. i, p. 426.

The British conchologists appear to consider they have well-defined characters for the separation of *T. Islandicum* and *T. propinquum*, the former having a mammillated apex, while in the latter the volution is commenced from a much smaller point; the pullus of each being sufficient to determine the species. In addition to which the *propinquum* is said to be comparatively much shorter and more tumid, or less elongated than the other. My Coralline Crag specimens appear to preserve a sort of intermediate character, and I have thought it necessary to give an enlarged representation of the spire of our shell, which is certainly not mammillated, and corresponds in its elongated and elegant form with *T. Islandicum*, having eight volutions, with a length of one inch and a quarter, and its greatest diameter $\frac{7}{16}$ ths of an inch: thus appearing to unite the distinguishing characters of the two recent species. The specimens from the Red Crag are tolerably abundant, but the apex—the character by which it is said to be distinguished—is generally more or less injured. It has been found at Bridlington, and in the Drift in Ireland.

TROPHON FABRICII, *Beck.* Tab. XXXI, fig. 4.

TROPHON FABRICII. (*Beck*) ex *Möller.* Ind. Moll. Groenl., p. 14, 1842.

TRITONIUM CRATICULUM. *Fabricius.* Faun. Groenl. Fide *Möller.*

FUSUS FABRICII. *Forbes.* Mem. Geol. Surv., vol. i, p. 425.

Spec. Char. *Testá ovato-turritá, vel ventricosó fusiformi; costatá, costis acutis, angulatis; transversim striatá, striis prominulis remotis; aperturá ovatá; labro incrassato, intus lævi; caudá brevi; columellá planá.*

Shell ovately turreted, or ventricosely fusiform; costated, ribs sharp and angulated; transversely striated, striæ slightly prominent and remote; aperture ovate; outer lip thickened, smooth within; canal short; columella plain.

Length, $\frac{5}{8}$ inch.

Locality. Drift Beds, Wexford (*Forbes*).

Recent, Greenland.

“This beautiful species, which was not observed in the Drift Beds until found in Ireland by Captain (Major) James, is intermediate in its character between *Fusus scalariformis* and *Fusus Barvicensis*. It has the general form and ventricose whorls of the former, with the fimbriated ribs of the latter.”—*Forbes*.

The figure is from the only specimen that I have seen. It is in the Museum in Jermyn Street.

FUSUS FORBESI. *Strickland.*

"According to Mr. G. B. Sowerby, identical with *Fusus cinereus*, Say, an American species, synonymous with *Buccinum plicosum* of Menke."—*Forbes*, 'Mem. Geol. Surv.,' vol. i, p. 426.

Locality. Isle of Man.

"FUSUS BARVICENSIS. *Johnston.*

"Locality. *Fossil*, Irish Drift.

Living, Northern Coasts of Britain."

"FUSUS BAMFFIUS. *Donovan.*

"Locality. *Fossil*, one of the most generally diffused and abundant species in the British and Irish Glacial Beds.

Living, Northern and Arctic Regions of the European Seas, common on the Scottish Coasts, Greenland, Seas of Boreal America."—*Forbes*, 'Mem. Geol. Surv.,' vol. i, p. 425.

"FUSUS CURTUS. *Smith.* MS. Tert. Dep. of the Basin of the Clyde, Trans. Geol. Soc., 2d ser., vol. vi, p. 156, No. 26.

"F. Testâ oblongâ, crassiusculâ, lævigatâ, spiraliter striatâ; anfractibus subrotundatis quinque, ultimo majori; aperturâ oblongâ, magnâ; canali brevissimo obtuso. Long. 0·3, lat. 0·12, poll."

"This species has the form of many *Pleurotomata*, particularly of *Pl. filosa*, but it has not the notch near the posterior part of the outer lip which characterises that genus. I have, therefore, found it necessary to place it with the *Fusi*; the very short, scarcely evident canal, however, tends to separate it from the more typical species of *Fusus*."

The above description of the Clyde Beds fossil has been obligingly forwarded to me by Mr. Smith, of Jordan Hill; it was drawn up by the late Mr. G. B. Sowerby. From what I can learn of this shell, which I have not been able to see, it probably belonged to *Pl. reticulata*, Brown. *Pl. Trevellianum*, Turt. *Mangelia Trevelliana*, Forbes and Hanley.

"FUSUS nov. sp.? or variety of *F. CRISPUS*, *Brocchi* (?).

"A shell measuring above an inch in length, fusiform, the whorls narrow, and crossed by prominent ribs, which are traversed by raised spiral ridges. The characters are those of *F. crispus*, of which it is probable an extreme form; but more perfect specimens are required for accurate determination. It is very distinct from any recorded Drift fossil.

"Locality. *Fossil*, Wexford.*

Living, *F. crispus* is at present a Mediterranean species.

"It occurs fossil in the Sub-Apennine beds."—*Forbes*, 'Mem. Geol. Surv.,' vol. i, p. 426.

There is a specimen from the Red Crag in my cabinet, which resembles this species; but it is in a worn and mutilated condition, and undeterminable. *F. crispus* is figured by Michalotti, 'Desc. des Terr. Mioc. de l'Ital. Septen.,' p. 272, No. 3, pl. 9, figs. 17, 18, who refers to *Borson*, 'Oritt. Piemont,' p. 317.

It is not mentioned by Brocchi.

* Every possible assistance has been most obligingly rendered to me by the officers of the Geological Survey, in their endeavours to discover this and some other Fossils, but all their exertions have been unsuccessful. Not anticipating the calamity that has deprived us of our lamented associate and friend, the late Professor E. Forbes, I did not think it necessary to apply to him respecting these species until I began to work upon the Appendix, knowing his ever-ready willingness to assist whenever occasion might require. My application has been thus unfortunately delayed, which I should the more regret were it not that his authority for the existence and correct determination of these species is quite sufficient without any endorsement I could give them.

NASSA PYGMÆA, *Lamarch.* Tab. XXXI, fig. 5.

RANELLA PYGMÆA. *Lamk.* Hist. des An. sans Vert., 2d ed., vol. ix, p. 550, No. 14.

— — *Kiener.* Coq. viv. (*Ranel*), p. 33, pl. 10, fig. 2.

TRITONIA VARICOSA. *Turt.* Zool. Journ., No. 7, p. 365, t. 13, fig. 7.

NASSA INCRASSATA, var. *Flemg.* Brit. An., p. 340, 1828.

— PYGMÆA. *Forb.* and *Hanl.* Hist. Brit. Moll., vol. iii, p. 394, pl. 108, figs. 5, 6.

Spec. Char. *Testâ turratâ, costatâ et spiraliter striatâ, costis numerosis, striis creberrimis decussantibus; sæpe varicibus in anfractibus superioribus; aperturâ ovatâ, labro extus incrassato, varicoso.*

Shell turreted, costated, and spirally striated, ribs numerous, with close-set striæ; upper volutions often bearing thickened ribs or varices; aperture ovate; outer lip thickened externally.

Length, $\frac{1}{8}$ inch.

Locality. Cor. Crag, Sutton.

Recent, Britain.

A single specimen, but not in good condition, is in my cabinet, and appears to correspond with what the British conchologists have confidently proposed as a distinct species. I believe the Crag fossil to be identical with the living shell.

I have withheld a notice of this, as well as a few other imperfect specimens from the Crag, up to the present time, in the hope of being able to procure something better to represent than what I am now only able to give.

NASSA MONENSIS, *Forbes*, MS.

NASSA MONENSIS. *Strickland.* Proc. Geol. Soc., vol. iv, p. 8.

In the first volume of my Monograph, p. 31, t. 3, fig. 5, a Red Crag shell was considered to have belonged to the above species, and it was inserted as such upon the authority of the late Professor E. Forbes. Mr. Smith has recently sent me a MS. note, accompanied with a sketch, by the original discoverer, of what is there called *N. Monensis*. "*Nassa* differing from *N. macula* in having the spire less produced, the body whorl much more ventricose, and the longitudinal ribs fewer. It appears intermediate between *N. macula* and *N. ambigua*." Forbes. The figure presents some considerable differences from the Crag shell, and I regret my inability to obtain a sight of the Manx specimen; they must, therefore, remain united for the present.

NASSA PLIOCENA. *Strickland.* Proc. Geol. Soc., vol. iv, p. 9.

Locality. Isle of Man.

This shell I have been unable to obtain a sight of.

Nassa reticulata is enumerated in Mr. Smith's 'List of the Clyde Fossils,' 'Proc. Geol. Soc.,' vol. iv, p. 9.

"BUCCINUM CILIATUM. *Fabricius.*

"Syn. (a variety.) *Buccinum Humphreysianum*, Bennett. Possibly, *Buc. fusiforme*, of Broderip, may be an extreme form of this species.

"*Locality.* Fossil, North of England and Scotland.

Living, very rare in the British Seas, common in Arctic Seas and on the Banks of Newfoundland."—*Forbes*, 'Mem. Geol. Surv.,' vol. i, p. 427.

This is another recorded British Tertiary fossil that I have been unable to obtain a sight of.

CANCELLARIA SCALAROÏDES, *S. Wood*. Tab. XXXI, fig. 9.

CANCELLARIA CORONATA. *S. Wood*. Crag. Moll., part 1, p. 64.

I have here introduced the figure of a specimen from the Coralline Crag, at Sudbourne, given to me by Mr. Charlesworth, since the publication of my first part, and as it presents a variation in character from those previously in my possession from the Red Crag, it is desirable it should be represented. From this more especially, and from a further examination of the other specimens, I am induced now to believe the Crag shell to be distinct, and to be intermediate between *C. varicosa*, Broc., and *C. coronata*, Scacchi. In this Coralline Crag specimen the costæ are very few, not more than seven in the last volution, like those of *varicosa*, but the upper part is more angular than in that species, and it differs from *coronata* in not only having fewer costæ, but the outer lip of our shell is furnished with numerous ridges or teeth, about ten, apparently at all ages; and there are three distinct folds upon the columella, the upper one small, the middle one the largest; while in *varicosa* the upper one is the large one. The form of the aperture is also different from what is represented by Philippi in the figure he has given of *C. coronata*. The form of our shell approaches that of *Fusus*, the proportions of the aperture being little more than one third of its entire length: although these dimensions may vary in several specimens, and is a character of no very great importance, but, united with other differences, give reason to believe our shell to be entitled to an isolated position. The Red Crag shell is probably the prolonged existence of the Coralline Crag species.

LACUNA VINCTA, *Montague*. Tab. XXXI, fig. 13, *a, b*.

TURBO VINCTUS. *Mont*. Test. Brit., vol. ii, p. 307, pl. 20, fig. 3, 1803.

LACUNA VINCTA. *Turt*. Zool. Journ., vol. iii, p. 192.

— — *Gould*. Inv. Massach., p. 262, fig. 178*.

— CANALIS. *Turt*. Zool. Journ., vol. iii, p. 192.

— QUADRIFASCIATA. *Id*. Zool. Journ., vol. iii, p. 191.

— — *Lovén*. Ind. Moll. Scand., p. 22.

— DIVARICATA. *Id*. Ind. Moll. Scand., p. 23.

— PERTUSA. *Conrad*. Journ. Acad. Nat. Sci. Philadelph., vol. vi, p. 266, pl. 11, fig. 19.

PHASIANELLA BIFASCIATA. *Brown*. Illust. Brit. Conch., pl. 46, fig. 47, 1827.

Spec. Char. Testá ovato-conoidé, tenui; anfractibus convexiusculis, rotundatis; labro tenui, simplici; columellá latè angustá, excavatá, arcuatá.

Shell ovately conical and thin, with about four slightly convex or rounded volutions; outer lip thin and simple; columella elongated, curved, and excavated.

Length, $\frac{1}{2}$ inch.

Locality. Mam. Crag, near Norwich.

Clyde Beds.

Recent, Britain, Norway, and North America.

The shell, in the living state, to which my fossil is assigned as an identity, indulges in such considerable variation, that I have placed it there as its most probable position, and the longitudinal proportions between the varieties called *gracilis* and *quadrifasciata* would give a mean with which our fossil appears to correspond, approaching, however, rather nearer to the latter (like the fig. 169, *Gould*); but the three specimens in my possession are not in good preservation, and have lost the greater portion of the outer coating, by which the form is altered. One specimen presents a somewhat square outline to the aperture, resembling, in that character, *L. crassior*. The recent shells of this genus have

greatly perplexed the conchologist, and the condition of my fossils presents greater difficulties in their determination.

In the 'Memoirs of the Geological Survey,' vol. i, p. 423, *Lacuna Montacuti* is quoted as having been found in the Drift Beds of Ireland.

Littorina? suboperta, 'Crag Moll.,' vol. i, p. 118, t. 10, fig. 13. Since the figure here referred to was made, I have obtained a rather better specimen, which shows a flattened or slightly concave columella, the characteristic distinction of the genus *Lacuna*. It may, perhaps, with more propriety be called *Lacuna suboperta*.

Littorina neritoides, *rudis*, and *palliat*a, are enumerated in the 'List of Clyde Fossils.'

FOSSARUS SULCATUS, *S. Wood*.

PHASIANEMA SULCATA. *S. Wood*. Catalogue, 1840. *loc. cit.*

FOSSARUS CLATHRATUS. *Id.* Crag Moll., vol. i, p. 121.

The Crag shell was considered by myself as an identity with the Mediterranean species, which subsequent examination gives reason to believe is not correct; I have, therefore, ventured to restore to it the provisional name given in my 'Catalogue.' It resembles a recent British shell which I believe belongs to this genus, *Odostomia dolioliformis*, 'Hist. Brit. Moll.,' vol. ii, p. 301, pl. 97, fig. 5. Our fossil is, however, specifically distinct, and seems to preserve an intermediate character between *dolioliformis* and *clathratus*, being larger than the one, and smaller than the other, and more elongated than either. The ridge upon the columella is at times invisible, and is a character not to be depended upon.

ODOSTOMIA UNIDENTATA, *Montague*. Tab. XXXI, fig. 11.

TURBO UNIDENTATUS. *Mont.* Test. Brit., p. 324, 1803.

VOLUTA UNIDENTATA. *Mat. and Rack.* Trans. Lin. Soc., vol. viii, p. 121.

JAMINIA UNIDENTATA. *Brown.* Illust. Brit. Conch., pl. 50, figs. 34, 35, 1827.

ODOSTOMIA UNIDENTATA. *Forb. and Hanl.* Hist. Brit. Moll., vol. iii, p. 264, pl. 95, figs. 7, 8.

— PPLICATA. *Flem.* Brit. An., p. 310, 1828.

Spec. Char. Testâ minutâ, ovato-conoideâ, lævigatâ, anfractibus 5—6 convexiusculis, spirâ paulo longiore, aperture ovatâ, labro simplici, columellâ unidentatâ.

Shell small, ovately conical, smooth, with about five or six volutions, slightly convex; spire a little longer than the aperture, which is ovate, with a simple lip; columella toothed.

Length, $\frac{1}{16}$ inch.

Locality. Red Crag, Walton Naze.

Recent, Britain.

A solitary specimen of a shell of this perplexing genus has been recently obtained by myself from the Red Crag, and it appears to accord best with the shorter variety of the above-named recent British species, although it differs slightly in having the volutions at the base rather more rounded.

In the former part of my Monograph, *Od. plicata* and *Od. conoidea* are united as one and the same species, which I now believe to be distinct, as pointed out by the authors of the 'Hist. of Brit. Mollusca.' Both these species were in existence during the Crag Periods, the latter in the Coralline, and the former in the Red Crag.

A shell in my cabinet, from the Coralline Crag, strongly resembles *Od. eulimoides*; but the specimen is not in sufficiently good preservation for figure or description.

ODOSTOMIA TRUNCATULA? *Jeffreys*. Tab. XXXI, fig. 16.

ODOSTOMIA TRUNCATULA. *Jeff.* Ann. Nat. Hist., new ser., 1850, p. 150.

— — — *Forb. and Hanl.* Hist. Brit. Moll., vol. iii, p. 294, pl. 96, fig. 8, 1850.

Spec. Char. *Testá elongato-turritá, subulatá vel subcylindraceá, lævigatá, pellucidá? tenui; anfractibus 5—6 convexiusculis; aperturá ovatá, labro acuto; umbilico parvo; columellá obsoletè unidentatá.*

Shell elongately turreted, tapering, or nearly cylindrical, smooth, thin, and transparent? volutions 5—6, somewhat flattened; aperture ovate; outer lip sharp; columella with an obsolete tooth, and small umbilicus.

Length, $\frac{1}{4}$ inch.

Locality. Cor. Crag, Sutton.

Recent, Britain.

Three or four specimens in my possession appear to correspond with the recent shell above referred to. In comparing my fossils with some specimens of the recent shell, obligingly presented to me by Mr. Barlee, the greatest difference appears to be in the apex, which, in the living shell, is somewhat flatter and more obtuse than in my fossil, whose apex is blunt or obtuse, but not flat, neither does it appear to have been reversed. My specimens unfortunately are not in the best state of preservation.

Assimineæ Grayiana is enumerated as a fossil by Mr. Dixon, in his 'List of Shells from the Upper Tertiaries of Bracklesham.'

RISSOA SOLUTA, *Philippi*. Tab. XXXI, fig. 10.

RISSOA SOLUTA. *Phil.* En. Moll. Sic., vol. ii, p. 130, pl. 23, fig. 18, 1844.

— — ? *Jeffreys*. Ann. Nat. Hist., vol. xx, p. 16.

— — ? *Forb. and Hanl.* Hist. Brit. Moll., vol. iii, p. 131, pl. 75, figs. 3, 4, 1850.

Spec. Char. *Testá minimá, elongato-turritá, lævigatá, anfractibus (quatuor vel quinque) rotundato-ventricosus, suturis profundis; aperturá suborbiculari.*

Shell minute, elongately turreted, smooth; whorls (four or five) roundedly ventricose, sutures deep; aperture nearly orbicular.

Length, $\frac{1}{16}$ inch.

Locality. Cor. Crag, Sutton.

Recent, Mediterranean.

I have found, in the Sutton sand, a single specimen of a shell which corresponds closely with the figure and description by *Philippi*, above referred to.

Messrs. Forbes and Hanley, p. 131, supra, have expressed great doubt respecting the existence of *Philippi's* species, and they have appropriated his name to the British shell. I fully participate in their doubt respecting the identity of the Mediterranean form with that found in our own seas; but, judging from the fossil now figured, I am much inclined to believe the Mediterranean shell to be a valid species; and in the event of its being hereafter so determined, I would suggest the name of *intersecta* for the recent British shell, as in that case *soluta* must be retained for the one to which it was first given.

The Crag shell may be more particularly described as being somewhat thin, and now opaque, though perhaps transparent in the living state; quite smooth, without appearing to have lost its outer coating; although somewhat elongate in the spire (differing therein from the recent British shell), the apex is obtuse, with at least four volutions, and a deep suture, particularly the last (but not "disjoined"), and with a distinct and deep umbilicus. The outer lip is simple, not thickened by a ridge, neither is it toothed within; the aperture somewhat rounded, but the diameter of the opening is rather greater in a longitudinal direction, and is about two fifths the entire length of the shell, with the lower part slightly effuse.

RISSOA THERMALIS? *Linnæus*. Tab. XXXI, fig. 12, *a*, *b*.

TURBO THERMALIS. *Linn.* Syst. Nat., 12th ed., p. 1237, No. 629.

— MURIATICUS? *Beudant*. Ann. du Mus., tom. xv, p. 201.

Spec. Char. “*T. umbilicatâ oblongiusculâ, obtusâ, anfractibus teretibus lævibus.*”—*Linnæus*.

Shell elongately conical or subulate, naked, smooth, and glossy; volutions six, slightly convex; suture distinct and deep; apex obtuse, depressed; aperture ovate; inner lip adpressed, giving a pointed termination at the upper part; umbilicus small.

Length, $\frac{1}{4}$ inch. *Diameter*, $\frac{2}{3}$ of the length.

Locality. Clacton.

It is now most difficult, perhaps impossible, to say what *Linnæus* intended for the type of his *Turbo Thermalis*, as there are two or three species that might, with a moderate allowance of latitude in variation, be made to accord with the diagnosis of his shell, and, it is to be feared, have already been done so. I am unwilling to make “confusion worse confounded,” so have introduced our shell with the above name instead of imposing a new one, though not without great misgivings upon the propriety of doing so, particularly as *Linnæus*, in his description, says, “*T. semine Brassicæ paulo major.*”

Our fossil is by no means rare at Clacton, but the majority of my specimens were obtained from the clay or estuary portion of the deposit at that locality in association with marine or rather estuary species: *Cardium edule*, *Tellina Balthica*, *Trigonella plana*, *Mytilus edulis*, and *Balanus*. I have also found specimens in the sandy and purely fresh-water part of the cliff, with land and fresh-water shells, so that probably its animal inhabitant was capable of residing in water that was either fresh or brackish. Mr. John Pickering has presented me with some specimens of a recent shell identical with our fossil, and these, he tells me, were obtained in the ditches of brackish water near Gravesend, in Kent. Similar specimens were pronounced by Messrs. Forbes and Hanley, vol. iv, p. 267, to be only varieties of *R. ventrosa*, in which opinion I cannot coincide; and I am permitted by Mr. Pickering to say he believes the two shells to be specifically distinct.

This shell, or something very like it, was found by MM. Ehrenberg and Von Hemprich, “in fontibus Oasis Jovis Hammonis inter Alexandriam et Rosettam.”

JEFFREYSIA? PATULA, *S. Wood*. Tab. XXXI, fig. 14, *a*, *b*.

NATICA DEPRESSULA. *S. Wood*. Catal. of Crag Shells, Ann. and Mag. Nat. Hist., 1840, p. 530.

Spec. Char. *Testâ minutâ, subglobosâ, lævigatâ, politâ, tenui, vitreâ, pellucidâ? umbilicatâ; apice obtuso; anfractibus paucis 1—2 depressis; suturis profundis, excavatis; aperturâ magnâ, ovatâ, dilatâtâ; labro simplici acuto.*

Shell small, subglobose, smooth, glossy, thin, vitreous, pellucid? umbilicated; apex obtuse; volutions few, 1—2, depressed; suture deeply excavated; aperture large, ovate, expanded; outer lip thin and sharp.

Diameter, $\frac{1}{10}$ inch.

Locality. Cor. Crag, Sutton.

Three specimens of a small species were found by myself many years since, and reserved to the present time. They are now assigned provisionally to the above genus, more from the difficulty of finding a better position than from a satisfaction of their correct appropriation. They appear to differ from *Natica*, where

they were first placed, in having an obtuse instead of an acute apex, like all the species in that genus that I have examined, and the texture of the shell is vitreous and clear, and when living was probably quite transparent. The form much resembles that of *Natica*, but the peristome is continuous, and not impressed by the body whorl, nor is the inner lip spread out as in the species of that genus. I know of nothing strictly resembling it, and if the determination of the genus depend, as it is said, entirely upon the form of the operculum, it will probably be long ere it is correctly determined by that character.

PALUDINA PARILIS, *S. Wood*.

PALUDINA LENTA. *S. Wood*. Crag. Moll., vol. i, p. 110.

Since the publication of my first volume, wherein I had assigned the Crag shell as an identity with the fossil from the Older Tertiaries, and considered them both as the progenitors of a shell now living in the Nile, I have given to them a more extended examination, with an increased number of specimens, and have reason to believe they are all three distinct.

I therefore propose the above name for the British Upper Tertiary Fossil, in lieu of the one it has hitherto borne.

PALUDINA MARGINATA, *Michaud*. Tab. XXXI, fig. 18, *a, b*.

PALUDINA MARGINATA. *Mich.* Comple. de l'Hist. Nat. des Coq. Terr. et Fluv. de la France, p. 98, No. 11, t. 15, figs. 58, 59, 1831.

— — — *Lyell*. Man. Elem. Geol., p. 127, fig. 112, 1851.

— MINUTA. *Strickland*. Silur. Syst., p. 555.

— — — *Lyell*. On the Boulder Formations and F. W. Deposits of Eastn. Norf., Phil. Mag., ser. 3, vol. xvi, No. 104, p. 354, fig. 4, 1840.

Spec. Char. “*Testâ minimâ, pellucidâ ovatâ, nitidâ, albidâ, longitudinaliter substriatâ; anfractibus quinis, rotundatis; aperturâ ovato-rotundatâ; labro extus marginato; apice obtuso, papillato. Operculum ignotum.*”—*Michaud*.

Shell small, pellucid, ovate, naked, white, slightly striated longitudinally; volutions five, rounded; aperture roundedly ovate; outer lip outwardly marginated; spire obtuse, papillated. Operculum unknown.

“*Dimensions*, $\frac{3}{4}$ and $\frac{1}{4}$ line.”

Recent, Draguignan, South of France, Carouge, near Geneva (*Jeffreys*).

This species is, I believe, abundant at each of the localities in which it is found, and particularly so at Clacton. The generality of specimens do not exceed the dimensions given by Michaud to the recent shell, though some few of my fossils have attained to the tenth of an inch in length, from the elongation of the spire, without increasing the number of volutions, in which case the suture is much deepened. The apex is very obtuse, the vertex being flattened, with the apical or embryonic portion broad and inflated. The outside of the aperture is strengthened by a thickened whitish rib, generally at a short distance from the margin, which is sharp and plain; the aperture is ovate, with the major axis in a longitudinal direction, scarcely at all impressed by the body whorl.

This is not now found living in Britain, and I have been unable to obtain any information respecting the soft parts of the animal. The thickened margin would rather indicate its having a calcareous operculum, like the genus *Bithinia*, but I have never found one, although the shell is very abundant.

NATICA SMITHII, *Brown*.

BULBUS SMITHII. *Brown*. Mem. Wern. Soc., vol. viii, p. 104, pl. 1, fig. 18, 1838.

NATICA — *Forbes*. Mem. Geol. Surv., vol. i, p. 430.

“The only specimen ever met with of this most interesting shell, a member of the division of ampullariform Naticæ, was found by the Duchess of Argyle in the Pleistocene Beds at Ardincaple. That specimen was presented to Mr. Smith, and was figured and described by Captain Brown, in the eighth volume of the ‘Wernerian Transactions.’ It has since, unfortunately, been destroyed. From its delicacy it is not likely to occur in the more disturbed beds of the Drift, but should be looked for in the Clyde Beds. It is extremely probable that when an opportunity for comparison may occur, the *Bulbus Smithii* will be found to be identical with *Natica flava*, of Gould; a rare living inhabitant of the Newfoundland Bank.”
—*Forbes*.

Mr. Smith, of Jordan Hill, to whom I have applied in the hope of being able to add something to the above remark, expresses his deep regret at the loss of the specimen referred to, which, he says, is the only one he has either seen or heard of.

NATICA BOWERBANKII, *Forbes*. MSS. Mem. Geol. Survey, vol. i, p. 430.

“In Mr. Bowerbank’s Bridlington Collection there is an imperfect specimen of a very distinct species of *Natica*, which does not agree with any living or fossil species known to me. It has a smooth, ventricose body whorl, angulated above, and a depressed spire. It equals *Nat. monilifera* in size.”—*Forbes*.

This is another, at present uncertain, species upon which, I regret to say, my endeavours to add a little information have not been crowned with success. Mr. Leckenby, who is well acquainted with the Bridlington fossils, kindly undertook to make inquiry for another specimen, but was equally unsuccessful. The shell in Mr. Bowerbank’s Museum is in that condition from which a determination would not be at all satisfactory.

NATICA ALDERI, *Forbes*.

(NATICA NITIDA, *Donovan*.)

This is said to have been found in the Drift Beds of Ireland and Scotland.

TROCHUS CRENULARIS. *Crag Moll.*, vol. i, p. 123, t. 13, fig. 7.

The specimen figured under this name at the above reference, I am now inclined to believe is a foreigner, and that the species does not belong to the Coralline Crag.

TROCHUS MAGUS, *Linn*.

Found in the Irish Drift Beds.

MARGARITA UNDULATA, *G. B. Sowerby*.

TROCHUS INFLATUS. *Smith*. Mem. Wern. Soc., vol. viii, pl. 1, figs. 10, 11.

Found in the Irish Drift and in the Clyde Beds.

BULLA CONULOIDEA, *S. Wood*.

The shell called *B. conulus*, *S. Wood*, 'Mon. Crag. Moll.,' part 1, p. 173, t. 21, fig. 2, is, I now believe, distinct from the Paris Basin shell, to which I had assigned it. A better examination with more specimens, some of which were obligingly forwarded to me by M. Deshayes, have shown that although the two shells are very closely allied, the differences are such as to warrant a specific separation. I therefore propose the above alteration for the Crag shell. The species from the Basin of the Adour, called by Grateloup, *B. conulus* and *B. angistoma*, which I had considered synonymous, I have been unable to examine whether they be more nearly related to the Older Tertiary or to the Crag species.

BULLA HYDATIS, *Linn.*

This is enumerated in Mr. Dixon's 'List of the Upper Tertiary Fossils at Bracklesham.'

BULLA AMPULLA.

Mentioned in Sir R. Murchison's 'Silur. Syst.,' p. 533, as a Tertiary fossil, found at Kempsey, near Worcester. I am unable to say whether these two be the same or different species.

BULLA ACUMINATA. *S. Wood*. Crag. Moll., vol. i, p. 174.

In the Synoptical Table at the end of the first volume of the 'Crag Mollusca' is a × against this name in the line of Eocene fossils, as if intended to denote the presence of the recent species, *acuminata*, during the Period of the Older Tertiaries.* This is a misprint; no mention is made of such existence in the text at the above reference. An unfigured species has, however, been found at Barton, closely resembling the recent shell in having a pointed or acuminate termination, with the spire enveloped, but the Older Tertiary fossil is evidently distinct.

Systematists appear to labour under great difficulties in the generic divisions of the Bullæ, the form of the shell appearing almost alone to determine the distinctions. Our little species rejoices in the title of several generic aliases. Prefessor Lovén has removed it from *Bulla* into a proposed genus called *Cylichna*. Messrs. Forbes and Hanley placed it (with a doubt) in *Ovula*. It was called *Volvula* by Adams; and Mr. Woodward has united it with *Tornatina*. A knowledge of the animal, when possessed, will assist in its true assignment, and may possibly justify a different position; but at present the shell alone is all we have to guide us as to its true relations, and from this it appears to differ only as a species from *Bulla cylindracea*, and other cylindrically convoluted shells, and whatever may be considered more essential distinctions for generic separation in such inflated species as *Bulla ampulla*, &c., the simple difference in this, at least from the cylindrically formed shells, is merely a greater elevation of the outer lip, so as to conceal the turns of the spire: or perhaps it would be more correct to speak of it as a prolongation of the outer lip into a pointed termination for the excurrent canal, instead of being at the junction or suture of the volution; an approximation to this may be seen in those species, such as *B. umbilicata*, &c., in which the outer lip is extended retreatingly or retreatingly, so as to cause a concavity where the spire is depressed but not hidden.

* This column contains also a few other crosses, intimating the supposed existence during the Eocene Periods of those species against which they are attached. Since that table was published I have given to them a more special examination, and although there are two or three (particularly the species of *Pleurotoma*) that present many characters in common, there is not one therein included that can be undoubtedly said to have lived during the joint Periods of the Older Tertiaries and the Crag.

APLYSIA? ASCIOLA, *S. Wood.* Tab. XXXI, fig. 24 *a, b*.

Locality. Cor. Crag, Sutton, Sudbourne.

This fossil has been in my possession for the last twenty years, with the above doubtful generic name, and my endeavours to obtain information as to its true character have hitherto been unsuccessful. There is a strong resemblance between it and one of the opercular valves of a Barnacle (*tergum*), but, with all my search, I have never been able to find what might be considered as its opposing portion—all my specimens have the point or apex inclining in the same direction; still I thought it might possibly belong to the Cirripedia; I therefore requested Mr. Darwin would be kind enough to give me his opinion upon them, but they were rejected by him as not belonging to any animal in the group he has so ably investigated.

Its form is that of a "little hatchet," and I have assumed it to be the calcareous portion of an internal shell, belonging, probably, to the section called *Aclesia* by Rang, and have placed it provisionally in the above generic position. At least fifty specimens have been found by myself, and these present considerable variation *inter se*, but I think they may be all referred to the same specific animal. One specimen is from Sudbourne; and this, though more than double the size of those from Sutton, was probably only from a larger individual, varying in that respect like the specimens of *Scalpellum*, as well as a few of the Mollusca from the same two localities.

Two fossils from the Upper Tertiaries of Sicily have been doubtfully described as species under the above generic title.

The inner portion or lining of *Pectunculus glycimeris* sometimes separates from the rest of the shell, and is occasionally found in the Red Crag; and when in that condition it strongly resembles the figure of *Aplysia grandis*, Philippi, 'En. Moll. Sic.,' vol. ii, t. 18, fig. 10, *a, b*; but I have not been able to see the Sicilian fossil.

PECTEN MAXIMUS. Tab. XXXI, fig. 25.

PECTEN MAXIMUS. *S. Wood.* Monog. of Crag Moll., *ante*, p. 22.

A single specimen of the flat valve of a species in this genus has lately been given to me by Mr. Whincopp, who obtained it from Sutton.

Although a considerable amount of variation is exhibited in my large series of specimens of what I have considered as *P. maximus* from the Coralline Crag, I have not seen anything quite so anomalous as is presented by this Red Crag specimen, and confess to be somewhat perplexed respecting it; still there is something peculiar in the arrangement of the ribs of this shell to warrant the belief that there has been a failure in their number of about one half, perhaps caused by what might be called a duplicature or union of the organs by which they were produced, and that it is nothing more than a monstrous form of the common British species.

There are six, or perhaps eight ribs, including those irregular ridges at the shoulders, rounded and smooth, probably made so by attrition; between them are some smaller rays, varying from two to five. In the recent shell these intermediate rays are also variable, and, in some specimens, they are very distinct and prominent, both between and upon the ribs, while in others they are entirely absent.

In order, therefore, to avoid the introduction of a species upon the slender evidence afforded by this specimen, I have called it *P. maximus*, var. *larratus*.

PECTEN POLYMORPHUS, *Bronn.* Tab. XXXI, fig. 20.

PECTEN POLYMORPHUS. *Bronn.* Reise, p. 627, sec. Phil.

- STRIATUS. *Marcel. de Serr.* Geog. des Terr. Tert. du Midi de la France, p. 131.
- STRIATULUS. *Lamarck.* Sec. Philippi.
- INÆQUICOSTALIS. *Id.* Sec. Philippi.
- ISABELLA. *Lamarck.* Sec. Philippi.
- FLAGELLATUS. *Id.* Sec. Philippi.
- FLEXUOSUS. *Id.* Sec. Philippi.
- POLYMORPHUS. *Phil.* En. Moll. Sic., vol. i, p. 79, t. 5, figs. 18—21.
- — *Dixon.* Geol. of Sussex, p. 16, fig. 3, 1850.
- — *Sismond.* Syn. Meth. Inv. Ped., p. 13, 1847.
- OSTREA STRIATA? *Brocchi.* Conch. Foss. Subap., p. 577, t. 16, fig. 17.
- DISCORS. *Id.* Conch. Foss. Subap., p. 581, t. 14, fig. 13.
- COARCTATA. *Id.* Conch. Foss. Subap., p. 574, t. 14, fig. 9.
- PLICA. *Poli.* Utr. Sic., t. 28, figs. 1—5.

Spec. Char. “*Testá subæquivalvi, suborbiculari, latiore quam longâ, longitudinaliter undulato-plicatâ, striatâ aut lævi, plicis 5—12, auriculis amplis subæqualibus, utraque basi angustatâ; i. e., sinu angulum rectum formante a lateribus divisâ.*”—Philippi.

Shell nearly equivalve, suborbicular, broader than long, longitudinally ribbed or plicated; ribs 5—12; auricles large and slightly unequal, and angulated at the base on each side.

Diameter, 1 inch.

Locality. Bracklesham.

This shell is, I believe, not very rare at the above locality, to which place, as far as I know, it appears to be restricted, as a British fossil.

It much resembles *P. Danicus*, and is, like it, subject to great variation; it differs, however, more especially in its auricles, which are larger and more equal.

This is a living species in the Mediterranean, and is found fossil at Gravina, according to Philippi.

The specimen figured is in the British Museum.

LIMOPSIS PYGMÆA. *Ante*, p. 71.

This is no longer an extinct species; it has been recently obtained alive by Mr. M'Andrew in the Arctic Regions.

LUCINA COLUMBELLA. *Ante*, p. 143.

I have been unable to obtain any further information respecting the integrity of this species. Its claim to the Red Crag is, I suspect, very doubtful.

CRYPTODON SINUOSUM. *Ante*, p. 134.

At the above reference the Older Tertiary shell, *Lucina Goodallii*, was considered only as a variety, as also the Boom shell, *Axinn's Benedenii*, De Koninck, and both were introduced as synonyms to the above Crag fossil. A better examination with fresh specimens induces me now to believe them distinct.

MACTRA TRIANGULATA, *S. Wood*. Tab. XXXI, fig. 21 *a—d*.

Spec. Char. *Testā parvā, ovato-triangularā, utroque obtusissimè carinatā, crassā, striatā aut sulcatā; dentibus lateralibus magnis, perpendicularibus striatis.*

Shell small, ovately and broadly triangular; both sides obtusely keeled, thick, striated, or rather sulcated; lateral teeth large, perpendicularly striated.

Length, $\frac{5}{8}$ inch.

Locality. Cor. Crag, Sutton.

Small specimens of this species are abundant, but they are always more or less decorticated, and, as the principal distinction is in the sculpture, they have until now remained in my cabinet as varieties of *M. ovata*. Two or three individuals have recently been obtained with a sufficiency of the outer surface to show that a difference existed between it and the recent shell, *M. ovata* (*M. elliptica*, F. and H.), such as, I now believe, will entitle this to a separate specific position: instead of being covered with numerous, fine, irregular, and sometimes inosculating striæ, like those upon the recent British shell, our fossil is ornamented with regular and distinct ridges, and deep sulci between them, corresponding in that character with Brocchi's description of *M. triangula*, Renieri, "transversim sulcata;" but Messrs. Forbes and Hanley have determined the *triangula*, Phil., (*M. lactea*, Poli, which I presume to be the same,) to belong to *M. subtruncata*, Mont. With these discrepancies, and not having been able to see the Subapennine fossil, the above name is given provisionally until it can be better determined.

LUTRARIA RUGOSA, *Chemnitz*. Tab. XXXI, fig. 26 *a, b*.

MACTRA RUGOSA. *Chemn.* Conch. Cab., vol. vi, p. 236, t. 24, fig. 236, 1782.

LUTRARIA RUGOSA. *Lamk.* Hist. des An. s. Vert., tom. v, p. 469.

— — *Desh.* Trait. Elem. Conch., t. 10, fig. 7.

— — *Sismonda.* Syn. Meth. Ped. Foss., p. 23, 1847.

— — *Dixon.* Geol. of Sussex, p. 17, 1850.

Ency. Method., pl. 254, fig. 2 *a, b*.

Spec. Char. "Testā ovato-oblongā, longitudinaliter densè striatā, et quasi costatā; areā anticā et posticā glabratā, obsoletè transversim striatā; margine exteriore crenulato; colore extus ex albido flavescente, intus calcareo."—Chemn.

Shell ovately oblong, striated and costated; anterior and posterior areas generally smooth; lines of growth visible; outer margin crenulated or wavy.

Diameter, 2 inches.

Locality. Bracklesham.

Recent, Coast of Portugal and Mediterranean.

This species, as a British fossil, appears to be confined to the above locality, where, I believe, it is not very abundant. This, like *Pecten polymorphus*, is no longer an inhabitant of our own shores. It is said to be found fossil at Astigiani. The specimen figured is in the museum in Jermyn Street.

Lutraria solenoides (oblonga) is enumerated in Mr. Dixon's 'List of Upper Tertiary Fossils at Bracklesham.'

PHOLADIDEA? Tab. XXXI, fig. 23.

This is the representation of a specimen obtained by Mr. John Middleton from the Crag "Diggings," near Woodbridge, and obligingly put into my hands for publication by Mr. Woodward, who considers it a genuine fossil of the Red Crag. It appears strongly to resemble the calcareous case of a species of boring Mollusc, and the generic position he has chosen for it is probably the correct one, belonging to the section *Martesia*, Gray. The interior is filled with mud or clay, and particles of sand, but the valves are gone. The exterior presents concentric ridges or elevations (about a dozen): these are in relief, and correspond with the depressions or furrows often seen in the cavities formed by the *Pholades*.

In my cabinet are some crypts of a similar form, excavated in a nodule of chalk found in the Red Crag, evidently the production of a boring Mollusc. In my specimens the valves are gone, and the walls in some of the cells are marked with concentric ridges.

The following existing British species, not found in any of the Crag Formations, are enumerated as belonging to the Upper Tertiaries of these kingdoms, in accordance with the authorities attached:*

PATELLA PELLUCIDA.

Irish Drift Beds. (*Forbes.*)

LUCINOPSIS (LUCINA) UNDATA.

Clyde Beds. (*Smith.*)

CARDIUM ACULEATUM.

Clyde Beds. (*Smith.*)

CYPRINA PROPINQUA.†

Clyde Beds. (*Smith.*)

CYTHEREA LÆVIGATA.†

Clyde Beds. (*Smith.*)

VENUS VERRUCOSA.

— STRIATULA (GALLINA).

Clyde Beds. (*Smith.*)

* When the Palæontographical Society was first established the Crag Formations were the allotted portions for my Monograph, while the more recent deposits of the British Isles were intended to form the subject of a separate work by James Smith, Esq., of Jordan Hill; and it was not until after the publication of my first volume that any alteration was made in this arrangement. Mr. Smith found the fossils of these Uppermost Tertiaries were, with so few exceptions, identical with existing species, that he thought they were not of sufficient importance for a distinct work: it has therefore devolved upon me to mention those few that have become extinct upon our own coasts, and this will in some degree explain the irregular and imperfect manner in which I have introduced the species; and as this has taken me rather beyond my original intention, it has affected the correctness of my former title-page, and rendered it necessary to substitute a new one.

† These two species, noticed by Mr. Smith in his paper upon the 'Post-Tertiary Deposits of the Basin of the Clyde,' 'Trans. Geol. Soc.,' 2d series, vol. vi, p. 155, he still thinks are decidedly distinct, and such

TAPES PULLASTRA (VENERUPIS PERFORANS).

— DECUSSATA.

Clyde Beds. (*Smith.*) Bracklesham.* (*Dixon.*)

CERATISOLEN (SOLEN) LEGUMEN.

Clyde Beds. (*Smith.*)

ANATINA CONVEXA.

Irish Drift Beds. (*Forbes.*) Clyde Beds. (*Smith.*)

The woodcut (p. 328) is the representation of a specimen belonging to Mr. Acton, who kindly put it into my hands for illustration as a new species, but I have no doubt of its true position, and it is placed unhesitatingly in specific association with the characteristic shell of the Red Crag.

This extraordinary individual is the widest deviation from the normal condition of a species that has ever come under my observation, for although it is not very uncommon to see a fresh-water discoidal shell, owing to a little deflection in its spiral, assume a turriculated or conical character, it is exceedingly rare to see an elevated or turriculated shell become depressed into a discoidal form, with its volution upon a horizontal axis. My old friend *Littorina littoreus* has indulged in extraordinary vagaries, but our present specimen has carried its divergence to an extreme of deformity, emphatically showing that in the practical study of the Univalve Mollusca little real aid is to be derived from any mathematical accuracy in the angle of volution.

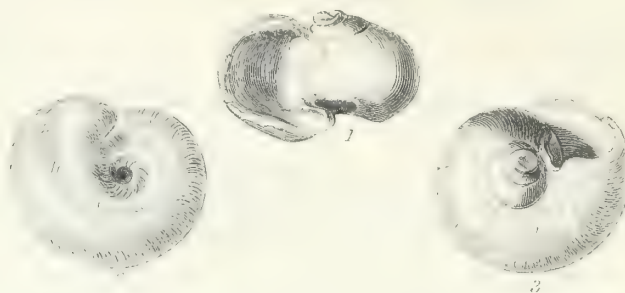
There is, it is well known, an inherent tendency to variation in some species, and this, though not wholly dependent upon external conditions, may be aggravated by what is unfavorable to a healthy development. The abnormous forms of *Littorina littoreus*, *Purpura lapillus*, and *Cardium edule*, found in the Estuary Deposits near Norwich, arose, I imagine, from the latter circumstance, as a very large number of individuals in this locality have become more or less distorted; and as these species in the recent state are rarely eccentric, their deformities were attributed by myself to some extraordinary alteration of the medium in which the animals lived, probably from changes produced by ice or by an excess of outflow whereby the saline properties of the water were prejudicially and suddenly diluted; but the varieties of a species in the

was, he says, the opinion of the late Professor E. Forbes, in whose hands they were placed: unfortunately they are not now to be found.

In the report of the twenty-fourth meeting of the British Association, held at Liverpool, September, 1854, p. 78, 'Geol. Sect.,' is a communication by Mr. P. P. Carpenter, respecting some land, fresh-water, and marine shells, obtained by Miss Bright from the depth of one hundred feet in the sinking of a well on the banks of the Avon, at Birlingham, Worcestershire. Among the fresh-water shells is mentioned *Limnæa glutinosa*; and with the marine ones are "two minute undetermined Bivalves, quite distinct from any known, either recent or in the Crag. One is an *Astarte*, very flat and triangular, with sharp ribs like *Gouldia Pacifica*, C. B. Ad.; the other is a ? *Lucina*, somewhat the shape of *L. columbella*, with a deeply cut lunule as in *Opis*, beginning with concentric ridges, then suddenly changing into radiating ribs."

* Some of the fossils at this locality appear to exceed considerably in dimensions the same species still in existence in our own seas. A specimen of *T. decussata*, given to me by Mr. Bristow, has attained the length of 3 inches. I have lately seen a fine specimen of *Pholas crispata*, measuring 4 inches, and am informed they have been found in this Deposit nearly 5 inches in length.

Red Crag may with less probability be assigned to such a cause, as there is no good reason to believe that the Mollusca in the remains of that Formation resided in very close proximity to the regions of fresh water. The unnatural condition of the present specimen appertains more to the individual than either to a species or to a colony, and may have arisen from some accidental circumstance, or from unsuitable food, or, what is perhaps more likely, the unlucky animal may when young have been caught and retained in some confined position, preventing its growth in a natural direction. It is an immature individual, although it has no doubt been "curtailed of its fair proportions" in consequence of its deformity.



Trophon antiquum, var. *contrarium planorbulum*.

From the Red Crag, Sutton.

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TAB. XXI.

Fig.

1. *Tellina crassa*, p. 226. From Red Crag, Sutton.
e, portion of surface enlarged.

2. *Tellina Benedenii*, p. 230. From Red Crag, Sutton.
a, *b*, show similarity of form in siphonal scar.
d, shows the equal tumidity of the two valves.

The siphonal side of fig. 2 *a*, was filled up by mistake; the specimen from which the figure was taken is imperfect, extending only to the fracture.

3. *Tellina fabula*, right valve, p. 232.

4. *Tellina balaustina*, p. 227. From Coralline Crag, Sutton.
d, enlarged portion of surface.

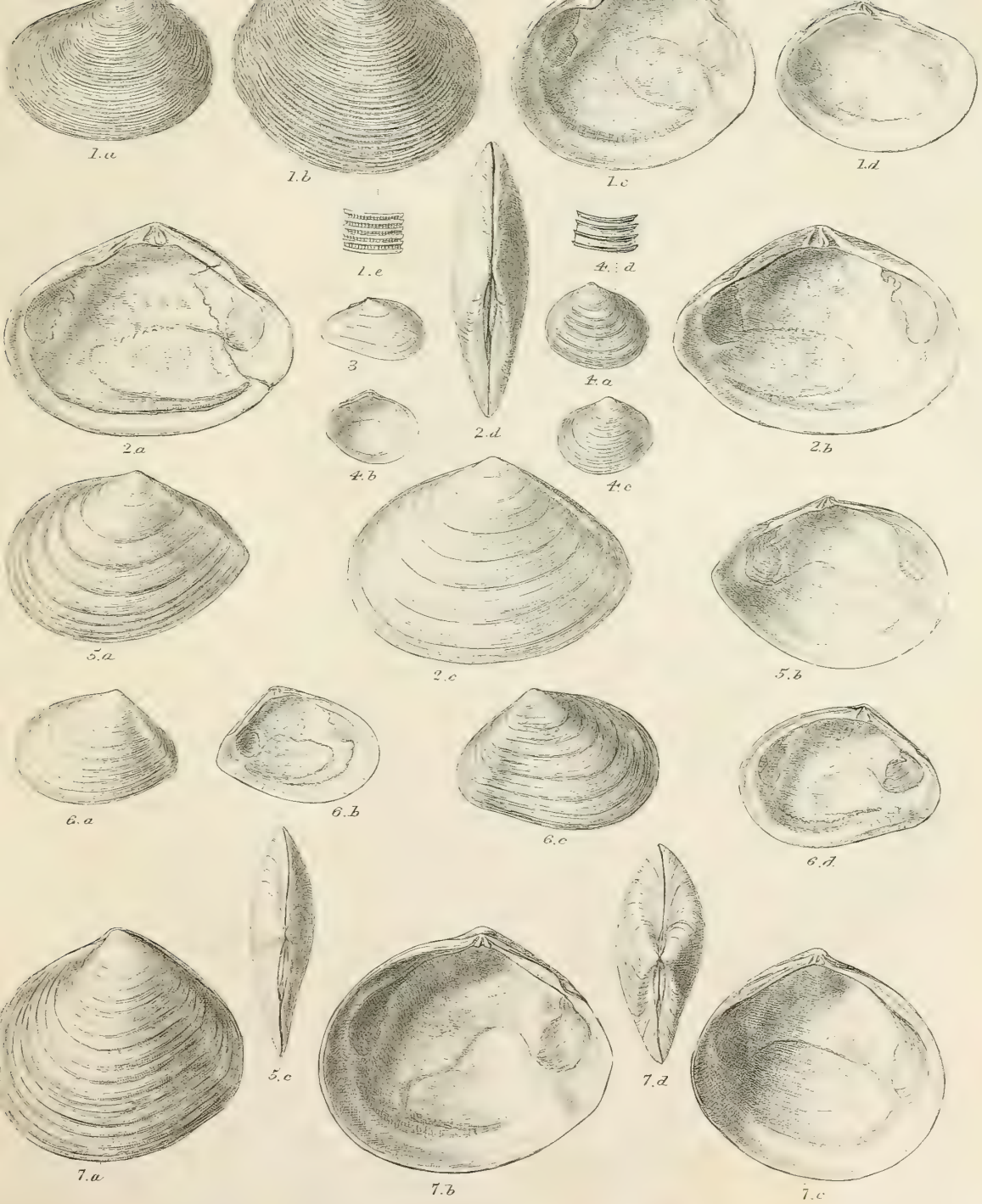
5. *Tellina prætenuis*, p. 230. From Red Crag, Sutton.

6. *Tellina lata*, p. 228. " "

7. *Tellina obliqua*, p. 228. " "

b, *c*, show the dissimilar forms of the siphonal scar.

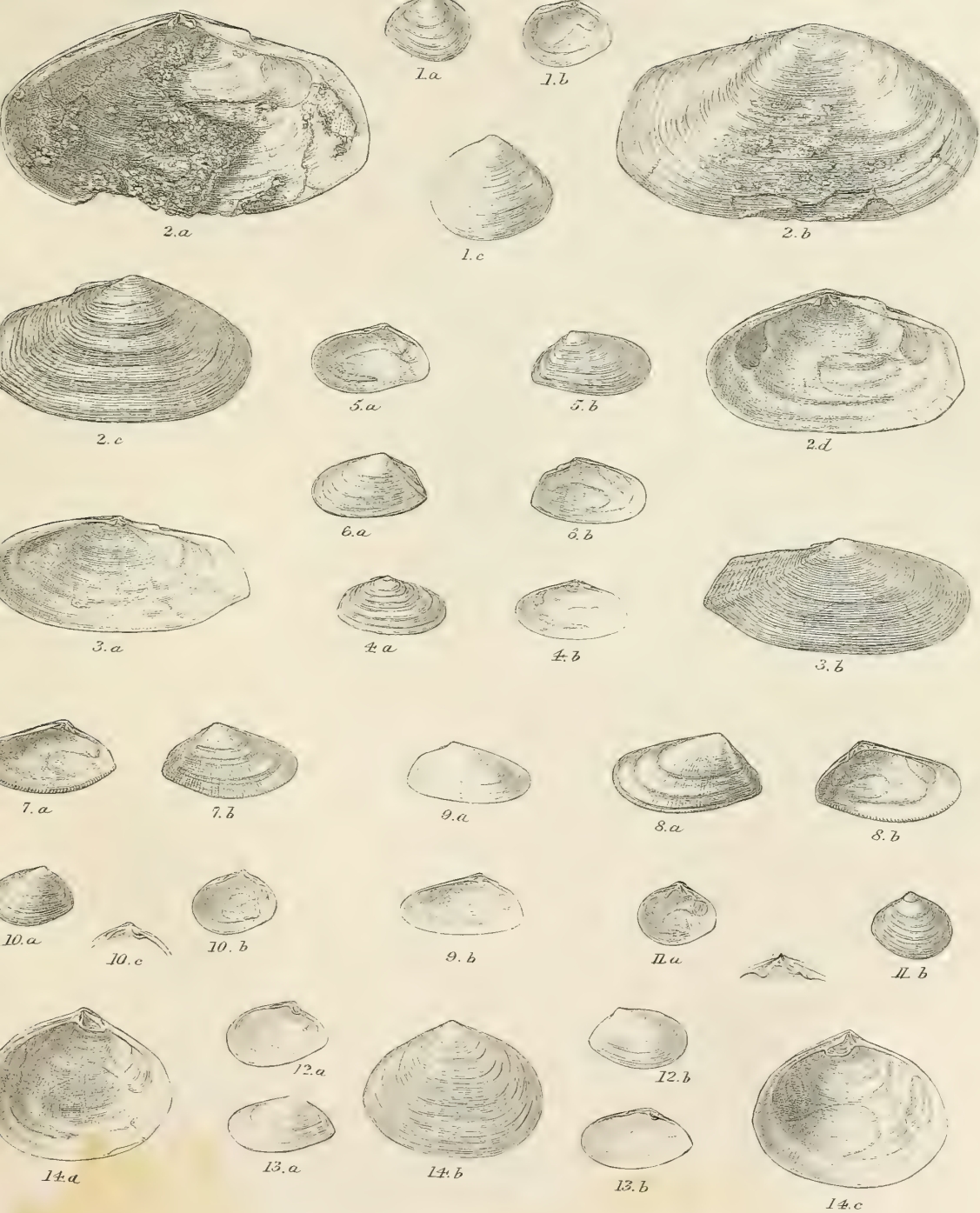
Note. This plate was engraved March, 1854.



TAB. XXII.

Fig.

1. *Tellina Balthica*, p. 231.
a, b, specimen from Clacton, found in clay, with *Unio littoralis*.
c, specimen from Mam. Crag of Norfolk.
2. *Psammobia vespertina*, p. 222.
a, b, representation of a monster valve from Sudbourne.
c, d, specimen from Ramsholt.
3. *Psammobia Ferröensis*, p. 221. From Coralline Crag, Sutton.
4. *Psammobia Tellinella*, p. 223. " "
5. *Tellina donacina*, p. 233. " "
6. *Tellina donacilla*, p. 234. " "
7. *Donax vittatus*, p. 219. From Mam. Crag, Bramerton.
8. *Donax trunculus*, p. 219. From Red Crag, Sutton.
9. *Donax politus*, p. 220. From Coralline Crag, Sutton.
10. *Abra alba*, p. 237. " "
c, enlarged hinge of right valve.
11. *Abra obovalis*, p. 240.
c, enlarged hinge of right valve.
12. *Abra fabalis*, p. 238. From Red Crag, Walton Naze.
13. *Abra prismatica*, p. 239. From Coralline Crag, Sutton.
14. *Trigonella plana*, p. 235.
a, c, show difference of form in palleal impression.



TAB. XXIII.

Fig.

1. *Mactra ovalis*, p. 246.

a, b, specimen from Mam. Crag, Chillesford.

c, d, specimen from Red Crag, Sutton.

2. *Mactra glauca*, p. 241. From Red Crag, Newbourne.

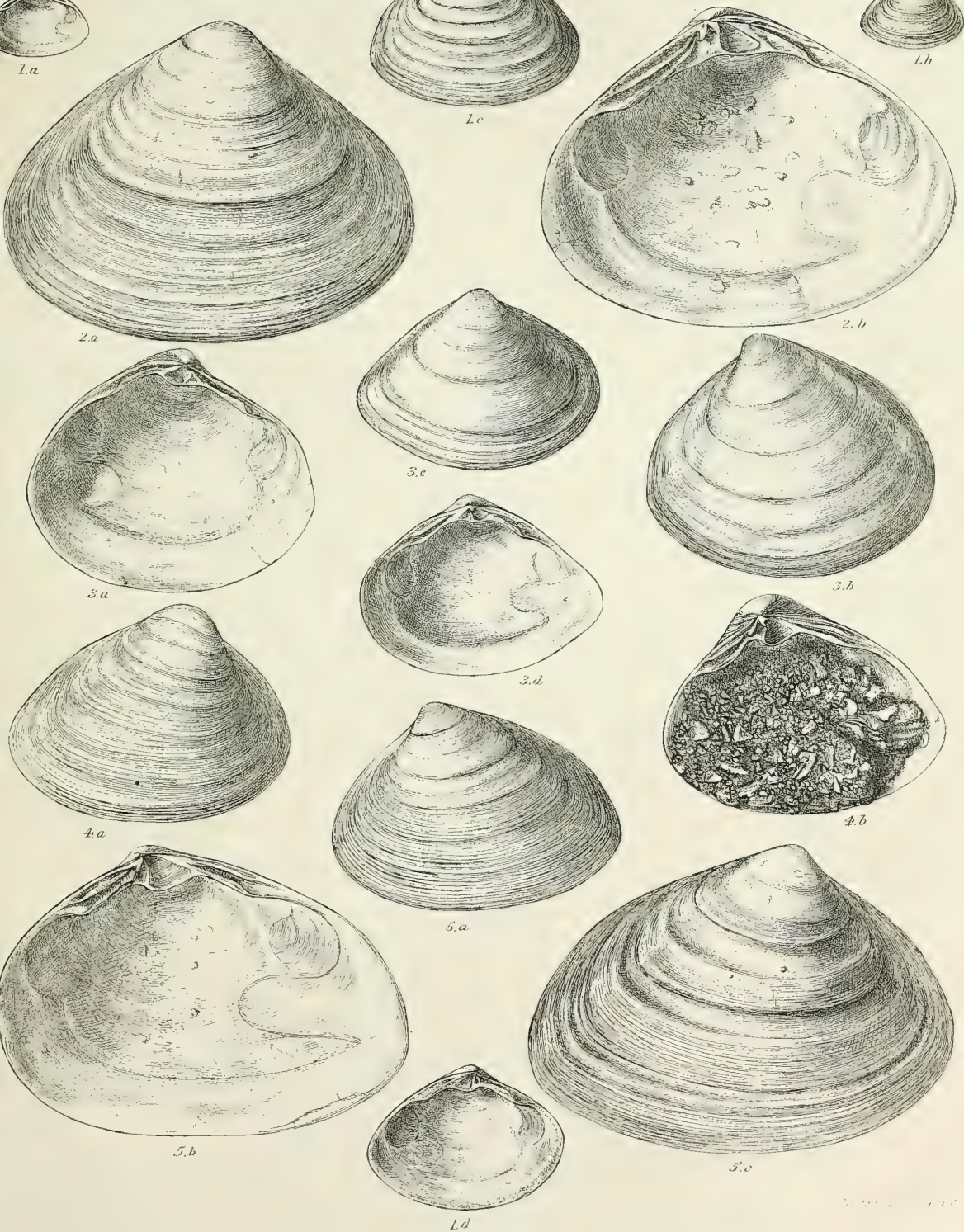
3. *Mactra stultorum*, p. 242. „ Sutton.

4. *Mactra artopta*, p. 244. „ Sudbourne.

5. *Mactra arcuata*, p. 243.

a, specimen from Ramsholt, Cor. Crag.

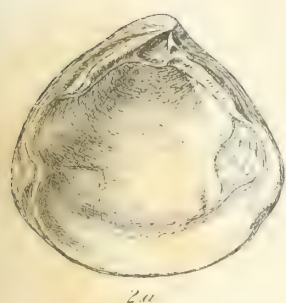
b, c, specimen from Walton Naze, Red Crag.



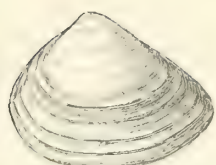
TAB. XXIV.

Fig.

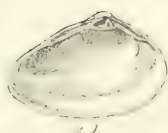
1. *Lutraria elliptica*, p. 251. From Coralline Crag, Ramsholt.
2. *Mactra truncata*, p. 245.
3. *Mactra subtruncata*, p. 247.
 - a*, specimen from Sutton.
 - b*, specimen from Bramerton.
1. *Mactra solida*, p. 245. From Red Crag, Sutton.
 - c*, a triangular variety probably of this species. It much resembles *M. striata*, *Smith*, 'Wern. Trans.', vol. viii, pl. 1, fig. 22, but it has the two sides more equal.
5. *Mactra obtruncata*, p. 248. From Red Crag, Sutton.
6. *Mactra constricta*, p. 249. ,, ,,
7. *Mactra deaurata*, p. 249.
8. *Mactra procrassa*, p. 244.



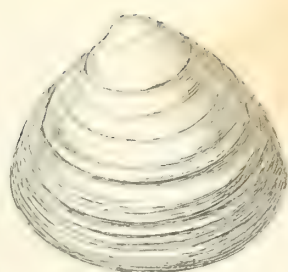
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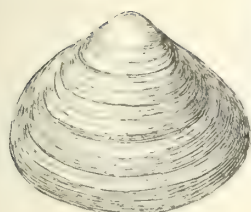
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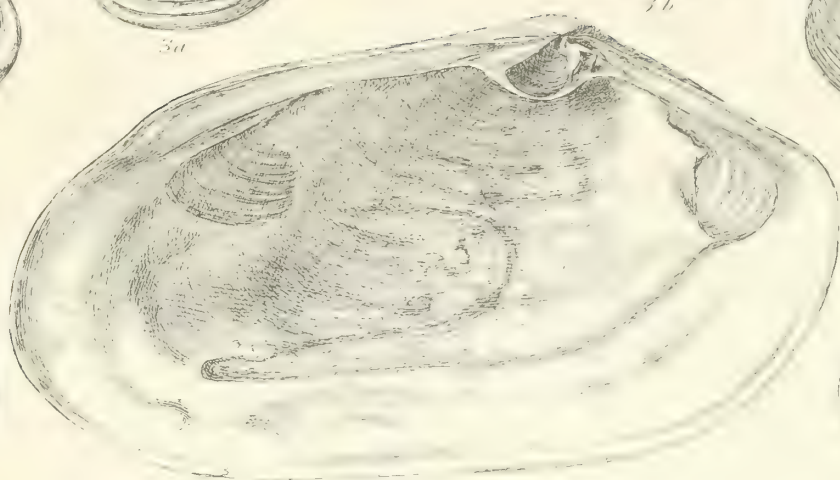
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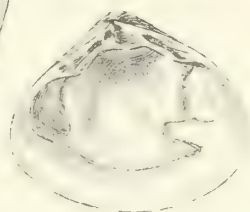
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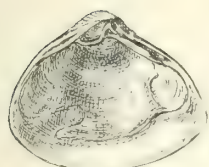
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1a



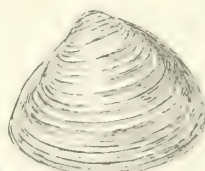
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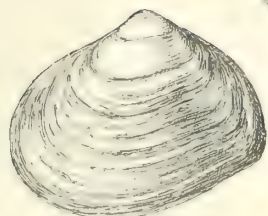
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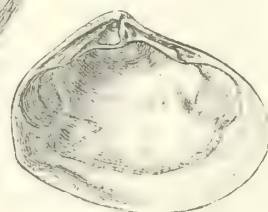
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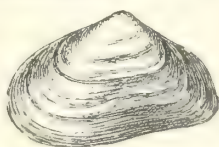
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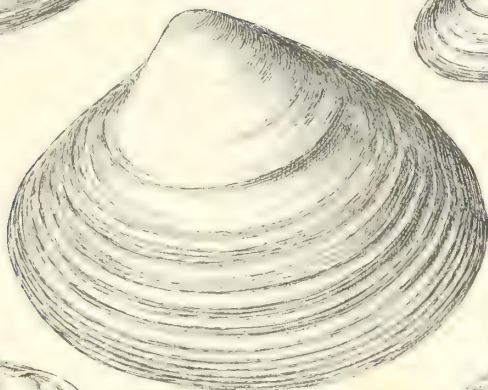
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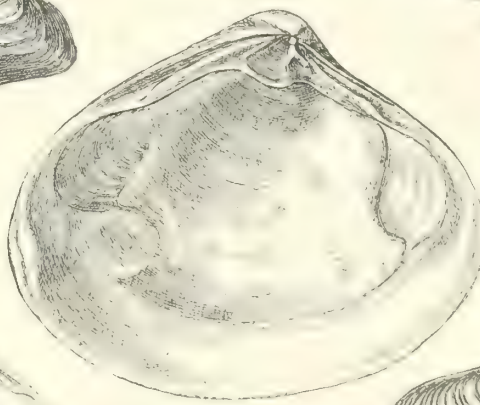
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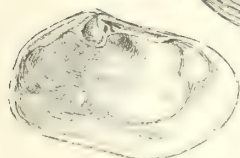
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8a



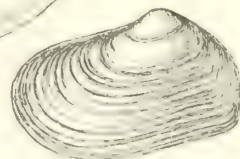
8b



7a



7c



7b



TAB. XXV.

Fig.

1. *Gastrana laminosa*, p. 217. From Coralline Crag, Sudbourne.
d, e, specimen distorted. From Red Crag, Walton Naze.
2. *Cultellus tenuis*, p. 258. From Red Crag, Walton Naze.
c, d, hinge of both valves slightly enlarged.
3. *Macha strigillata*, p. 252. From Coralline Crag, Sutton.
4. *Pandora Pinna*, p. 270.
5. *Pandora inæquivalvis*, p. 270.
6. *Solen ensis*, p. 256. From Red Crag, Walton Naze.
a—d, various specimens showing different proportionate dimensions.
e, f, exhibit muscular impressions.
7. *Solen siliqua*, p. 255. From Red Crag, Sutton.
b, d, interior view, to show difference in muscular impressions.
c, a small elongated specimen, with valves united.
8. *Solen gladiolus*, p. 254. From Red Crag, Walton Naze.*

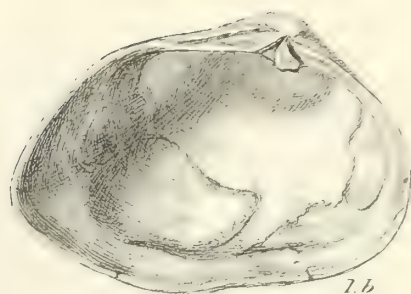
* In support of the presumption assumed in the note at page 255, that the Red Crag is not wholly derivative, it may be further remarked, that at the part of the cliff whence this specimen was obtained, there are no extraneous fossils whatever, at least none that I have been able to discover, which could be *decidedly* said were foreign to the deposit. The shells here rest immediately upon the London Clay, and are in the highest state of perfection; not only are there many Bivalves in their natural position, but the numerous specimens of the reversed variety of *Trophon antiquum* have the fragile apex or pullus seldom or never removed. Many species are also found that are not met with in the Coralline Crag; though this latter evidence is not of itself conclusive, it helps to sustain the argument deduced from the perfection of the specimens. The whole aspect of the Fauna at this locality differs from that of the White or Coralline Crag; the same also may be said of its lithological character, and, in my opinion, the probabilities are greatly in favour of the Red Crag, certainly at Walton-on-the-Naze, being pure and genuine, and of an Age geologically subsequent to the Coralline Crag.



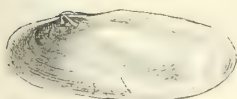
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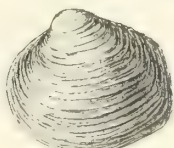
1.c



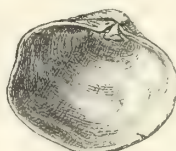
1.b



2.a



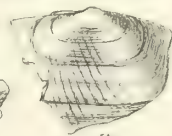
1.d



1.e



3.b



3.a



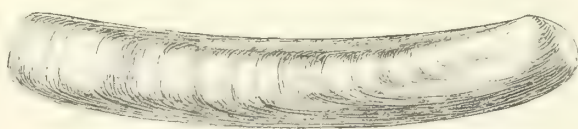
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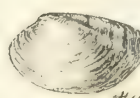
2.c



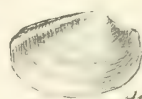
2.d



6.a



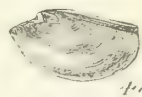
4.a



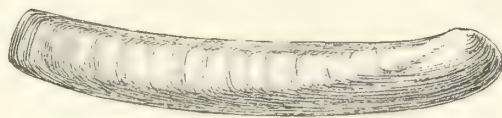
4.b



4.c



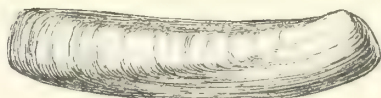
4.d



6.b



6.c



6.d



5.e



5.f



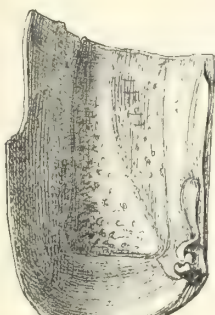
7.e



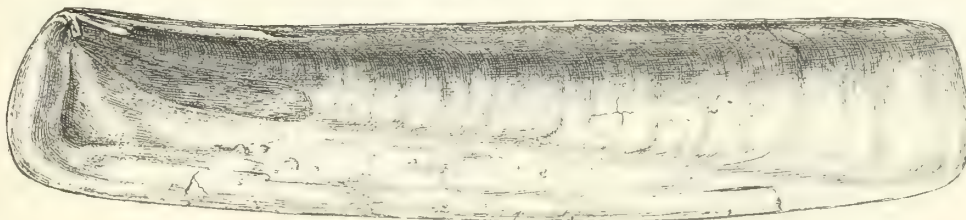
7.c



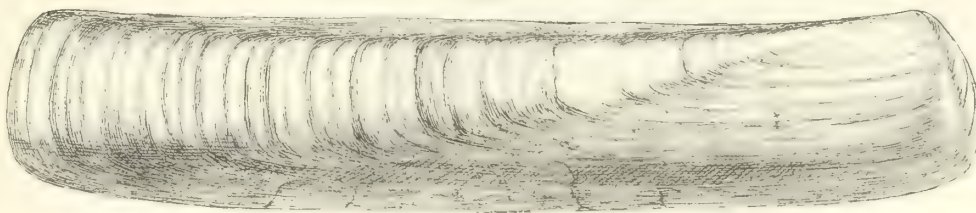
7.a



8.c



8.a



8.b



7.d



7.b

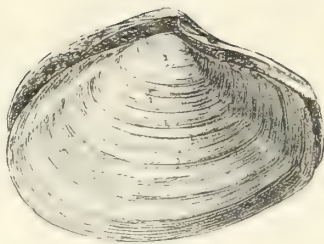
TAB. XXVI.

Fig.

1. *Thracia pubescens*, p. 259. From Coralline Crag, Sudbourne.
e, a distorted specimen, probably the young of this species. (*Thracia detruncata*, *S. Wood*. 'Catalogue of Crag Shells.')
2. *Thracia phaseolina*, p. 260. From Coralline Crag, Sutton.
e, a short *var.*, or perhaps the young of *pubescens*.
3. *Cochlodesma complanatum*, p. 263. From Red Crag, Walton Naze.
4. *Cochlodesma prætenerum*, p. 264. From Coralline Crag, Sutton.
5. *Thracia ventricosa*, p. 262. „ Ramsholt.
6. *Thracia inflata*, p. 261. „ Sudbourne.



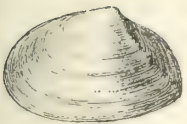
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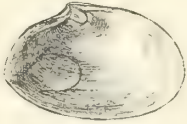
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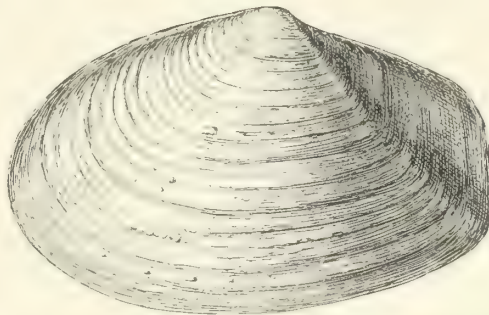
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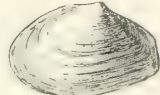
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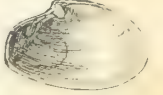
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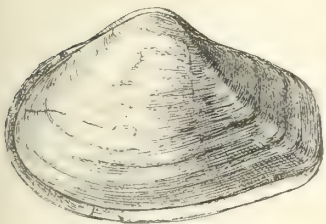
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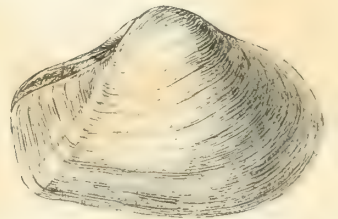
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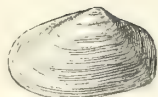
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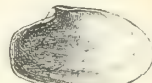
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5b



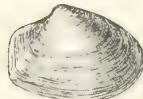
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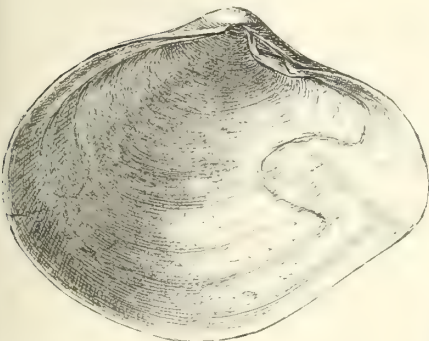
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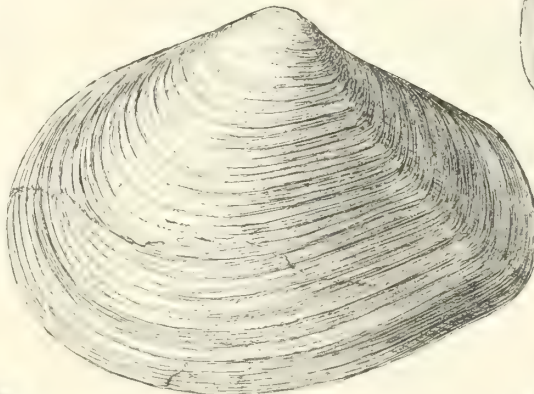
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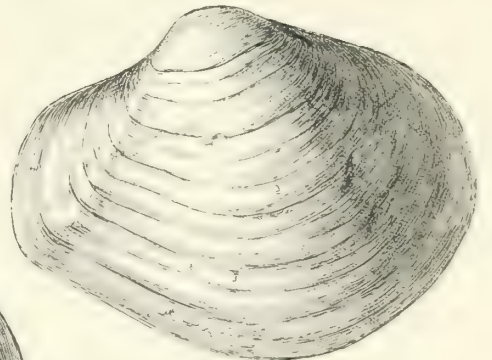
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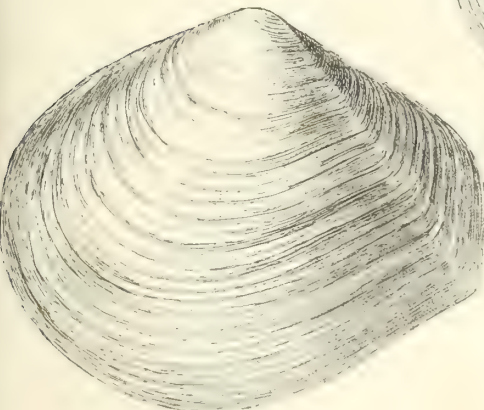
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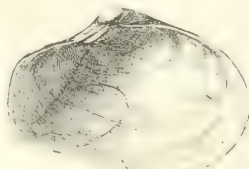
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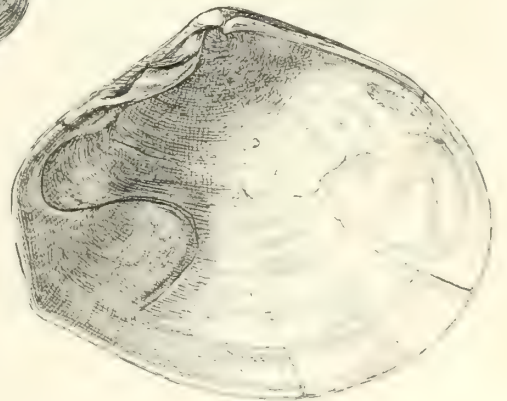
6b



6d



5c



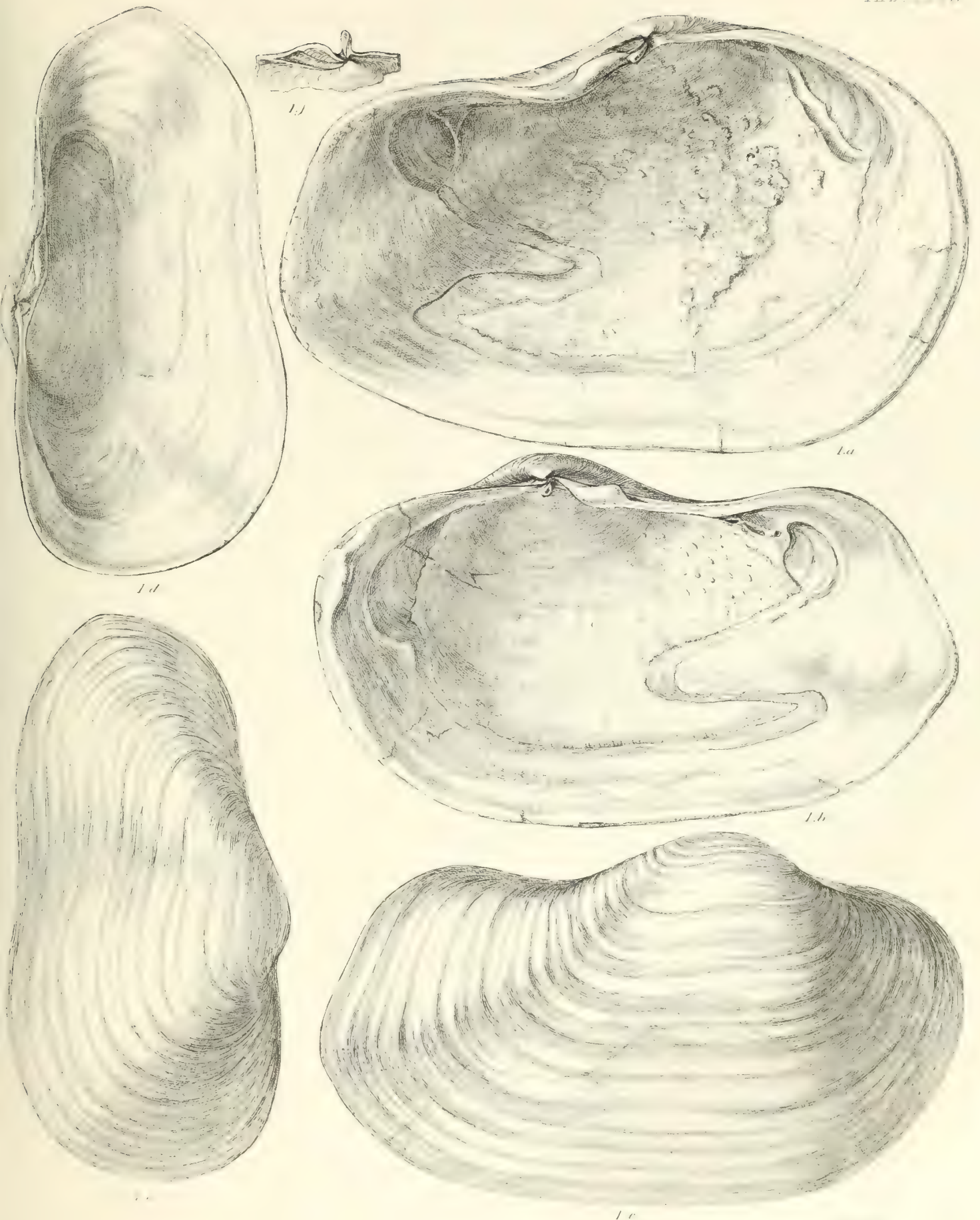
6e

TAB. XXVII.

Panopea Faujasii, p. 283.

a, b, c, from the Coralline Crag, Sudbourne.

d, e, var. gentilis. From the Red Crag.



TAB. XXVIII.

Fig.

1. *Mya truncata*, p. 277.

a, b, from Coralline Crag, at Ramsholt.

c, var. Uddevallensis. From the Clyde Beds.

d, e, var. pullus. From the Red Crag, at Butley.

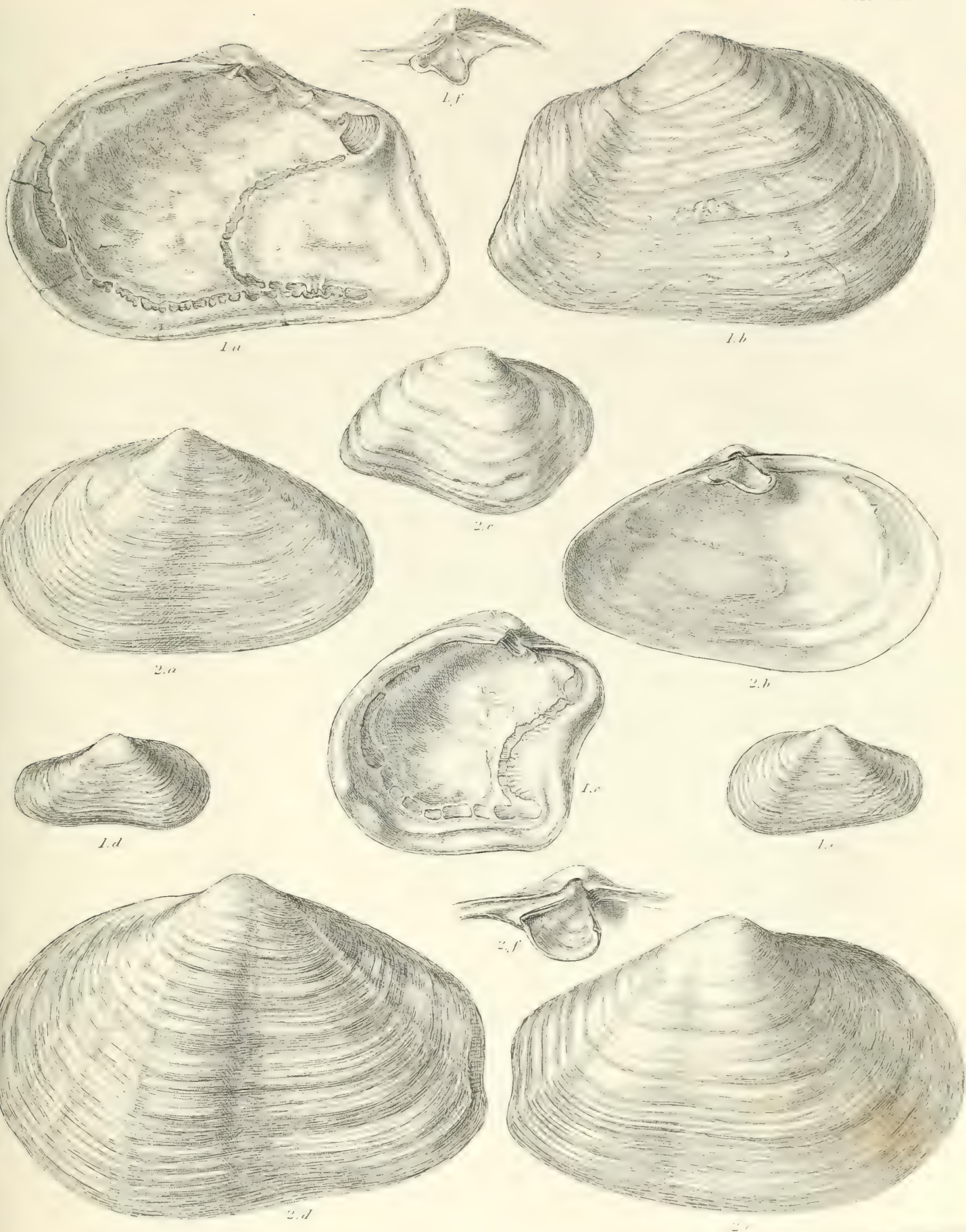
2. *Mya arenaria*, p. 279.

a, b, from the Red Crag, Sutton.

d, e, var. lata. From the Red Crag, Sutton.

c, distorted specimen, from the Mammaliferous Crag, Bramerton.

f, cartilage plate of *var. lata*.



TAB. XXIX.

Fig.

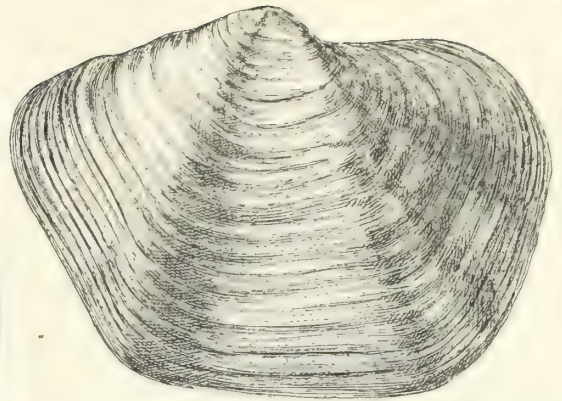
1. *Panopea Norvegica*, p. 281.
a, b, d, specimens from Chillesford, showing the siphonal side considerably the shorter of the two.
c, specimen from the Red Crag, Sutton, siphonal side the larger.
2. *Glycimeris angusta*, p. 291.
a, c, d, from the Coralline Crag, Sudbourne.
b, specimen rather more elongated, and less twisted, from the Red Crag, Sutton.
3. *Saxicava rugosa*, p. 285.
a, b, var. sulcata. Bridlington.
e, var. rustica. Valves united; from the Red Crag, Sutton.
f, var. distorta. Coralline Crag, Sutton.
g, var. cylindrica. Red Crag, Butley.
4. *Saxicava arctica*, p. 287.
a, (*Mytilus præcisus*, *Mont.*) Coralline Crag, Sutton.
b, (*Solen minutus*, *Mont.*) „ „
c, (*Agina purpurea*, *Turt.*) „ „
5. *Saxicava* ? *carinata* ? p. 289. „ „
a—d, figures enlarged; *e*, natural size.
6. *Saxicava* ? *fragilis*, p. 288. Coralline Crag, Sutton.
a—d, figures enlarged; *e*, natural size.
7. *Sphenia* ? *Binghami* ? p. 276. Figure enlarged. Coralline Crag, Sutton.



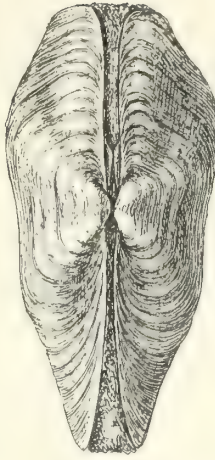
1.a



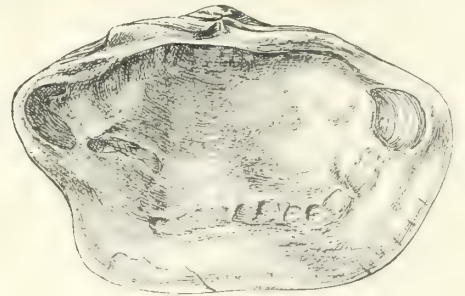
1.c



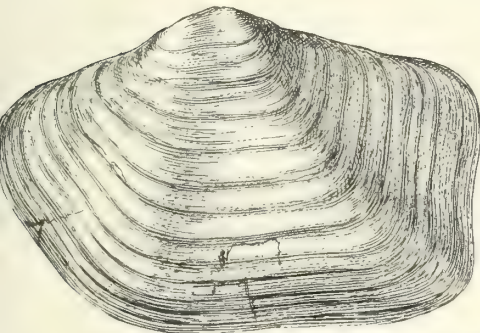
1.b



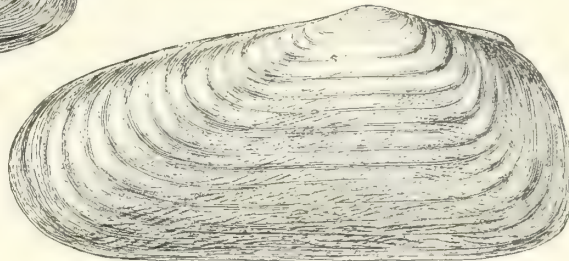
1.e



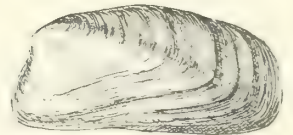
1.d



1.c



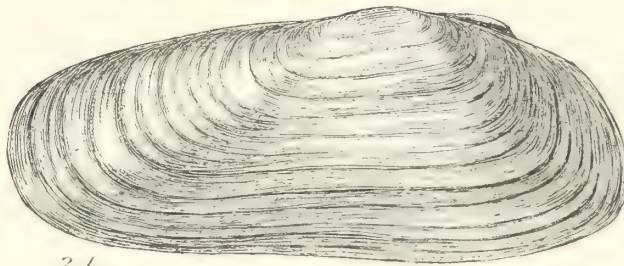
2.a



3.b



3.a



2.b



4.a



4.b



5.a



5.e

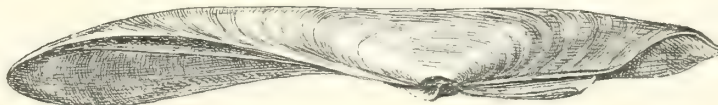


5.b



5.c

5.d



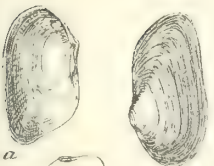
2.c



3.e



3.f



6.a



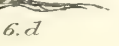
6.e



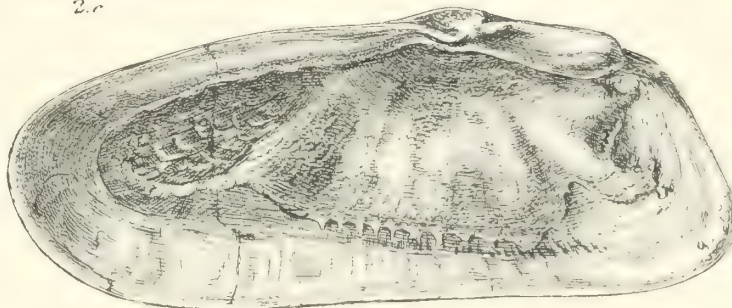
6.b



6.c



6.d



2.d



7

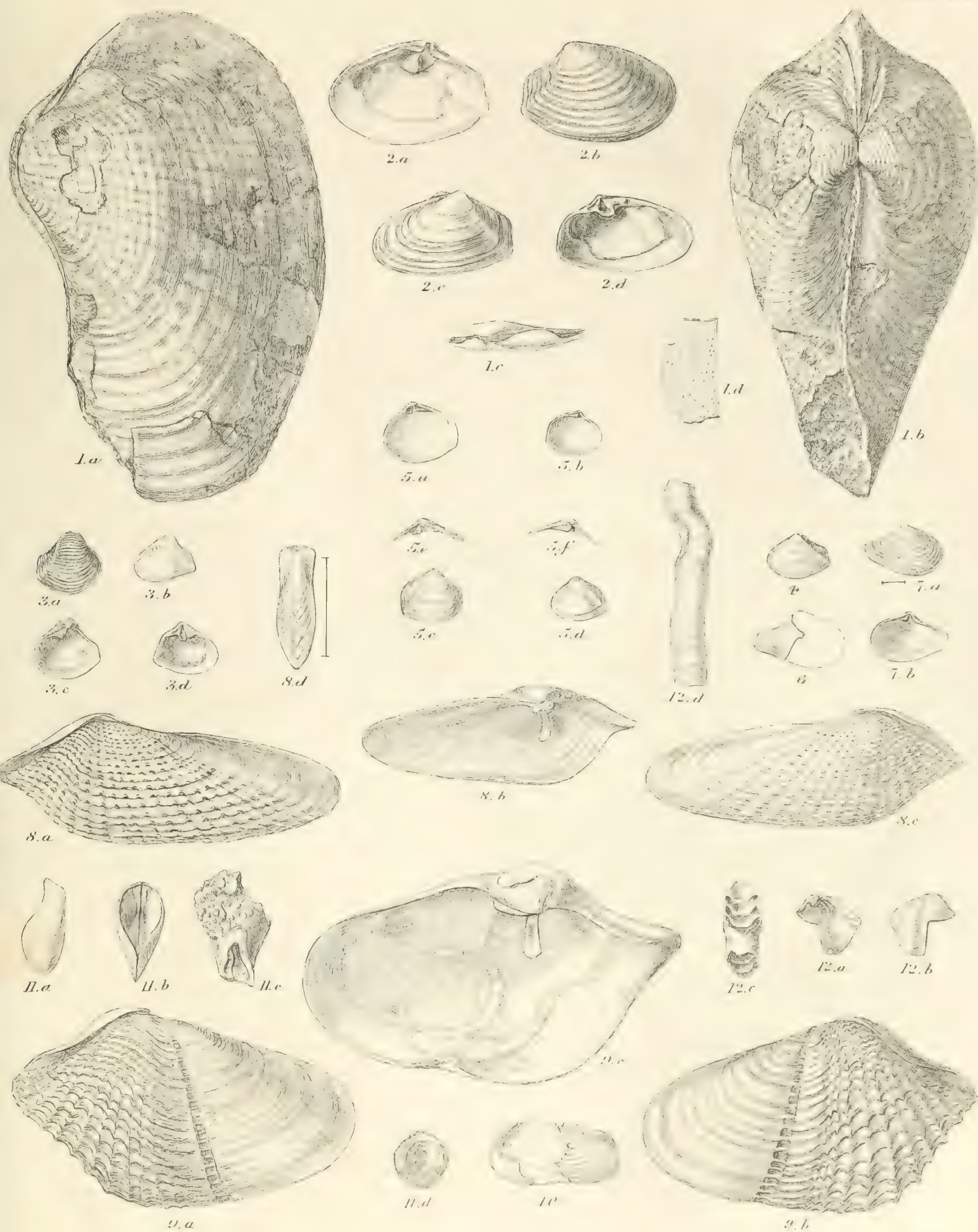


3.g

TAB. XXX.

Fig.

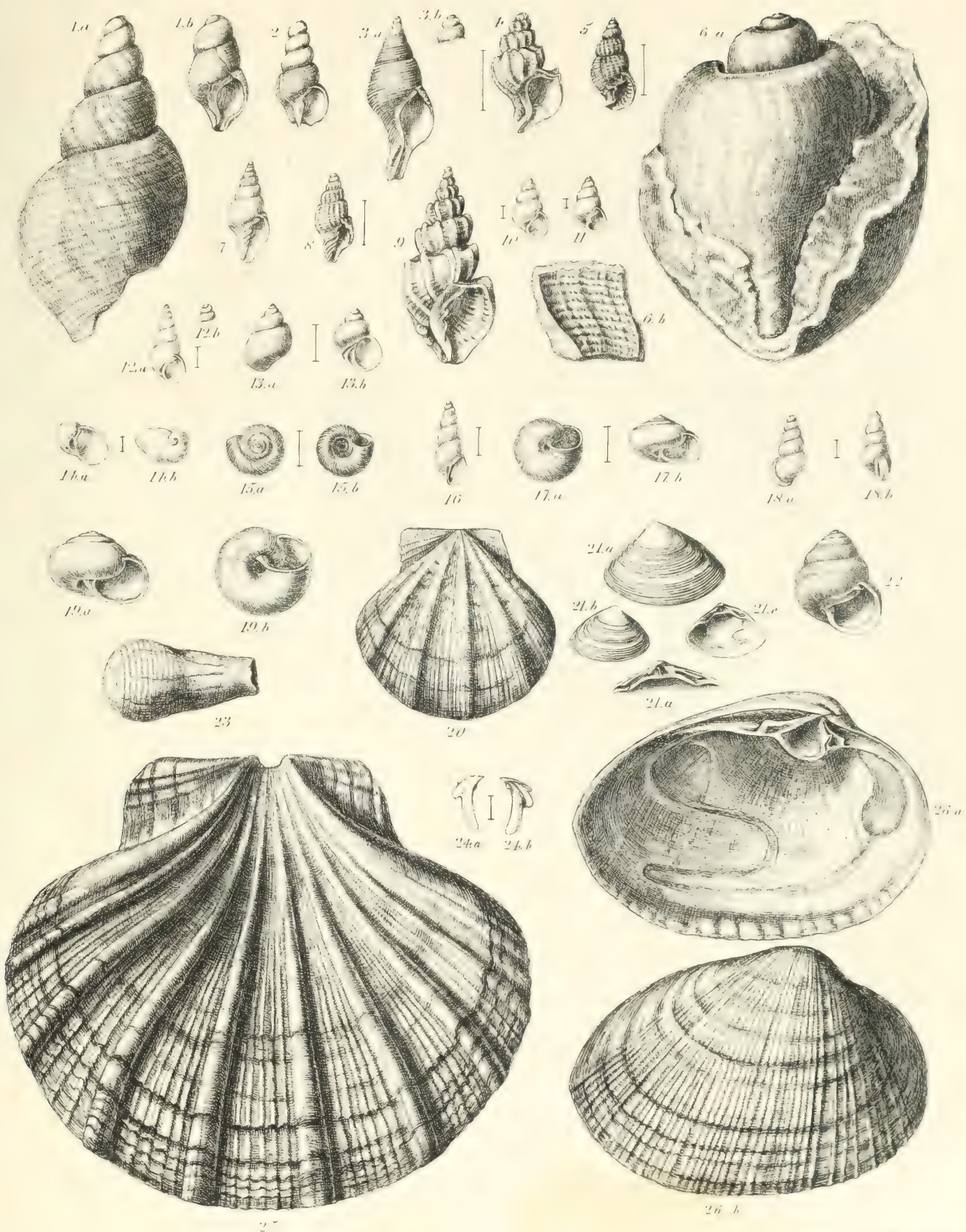
1. *Pholadomya hesterna*, p. 266. From Coralline Crag, Ramsholt.
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4. *Corbula rosea*? p. 275. ,, ,,
5. *Poromya granulata*, p. 268. ,, ,,
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d, accessory valve, probably of this species.
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c, posterior portion of tube, showing camerated partitions.
d, fragment of a thick tube; natural size.



APPENDIX. TAB. XXXI.

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Note. The lines denote the size of specimens.



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MONOGRAPH

ON

THE FOSSIL REPTILIA

OF THE

WEALDEN FORMATIONS.

PART III.

MEGALOSAURUS BUCKLANDI.

BY

PROFESSOR OWEN, F.R.S., F.L.S., F.G.S., &c.

LONDON:

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1856.

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MONOGRAPH
ON
THE FOSSIL REPTILIA
OF THE
WEALDEN FORMATIONS.

ORDER—*DINOSAURIA*.

Genus—*MEGALOSAURUS*,* *Buckland*.

Dentes laniarii, subcompressi, marginibus minuté serratis.

THE order or group of Dinosaurian Reptiles, briefly characterised in a preceding Monograph,† includes at least three well-established genera, resembling each other in having a large and complex sacrum, composed of five or more anchylosed vertebræ; in the height, breadth, and outward sculpturing of the neural arch of the dorsal vertebræ; in the twofold articulation of the ribs, or some of the anterior moveable ribs, to the vertebræ; and in having broad, and sometimes complex coracoids, and long and slender clavicles; whereby a Lacertian type of the pectoral arch is combined with a crocodilian type of the true vertebræ, and both with an ornithic type of sacrum.

These remarkable extinct Dinosaurs were of large, if not gigantic, size; with the trunk lifted, higher than in other reptiles, upon four unusually developed limbs; the principal bones of which are remarkable for the prominence and number of the apophyses relating to muscular attachments, for the size of the medullary cavity, and for the density of its compact bony wall: the limbs are terminated by metacarpal or metatarsal, and by phalangeal bones, which, with the exception of the ungual phalanges,

* Μεγας, great, σαῦρος, lizard.

† 'Palæontographical Society,' vol. 1855.

more or less resemble those of the horny pachydermal mammals, and attest, with the hollow long bones, the terrestrial habits of the species.

Of these gigantic *Dinosauria* the most formidable was that which its discoverer, that keen observer and original thinker, the Rev. Dr. Buckland, has called "*Megalosaurus*,"* in reference to the idea of its hugeness, which was suggested to both him and Baron Cuvier by certain of its limb-bones. "Si l'on pouvait donner," writes Cuvier, "le nom de *Lacerta gigantea* à un autre animal qu'à celui de Maëstricht, c'est l'espèce actuelle qui le mériterait; son seul fémur, long de trente-deux pouces anglais ou 0·805; annoncerait, en lui supposant les proportions d'un Monitor, une longueur totale de plus de quarante-cinq pieds de roi, et même, s'il y a de ces fémurs de quatre pieds et plus, comme on l'a dit, sa longueur serait encore plus étonnante."†

The locality where the first rightly recognised remains of the *Megalosaurus* were found was Stonesfield, near Woodstock, about twelve miles from Oxford. The formation is that calcareous schist, which, being quarried for roofing houses principally at Stonesfield, is called, in most English geological works, "Stonesfield slate." Its position is at the base of the great Middle Oolitic series, where it may be, perhaps, more accurately classed as an upper member of the Inferior Oolite.

To get at this slate, pits are sunk through forty-feet or more of superincumbent strata, chiefly consisting of that hard oolitic rock called "cornbrash" by the quarrymen. The schistose or slaty deposit is not more than six feet thick; and the scepticism with which the first announcement of bones of large animals in stony strata at that depth was received, is exemplified by the stress with which Cuvier thought it needful to insist on the fact that the Stonesfield slate was as regular a formation as it was an ancient one, and that there was no ground for supposing that the fossil bones which it contained had penetrated it by any fissure or other accidental opening.

The portions of skeleton originally discovered, and attributed by Dr. Buckland to his newly defined genus, *Megalosaurus*, consisted of a fragment of the lower jaw, a femur, a series of five vertebræ of the trunk, a few ribs, a coracoid bone, a clavicle, and some less certainly recognisable fragments.‡

Unfortunately, as Cuvier has remarked, those portions were not found together in one spot, nor, with the exception of the five vertebræ, were the bones associated two to two, or three to three, so as to make it probable that they belonged to the same individual; and, with regard to their zoological or anatomical relations, Cuvier further observes that these are of a somewhat equivocal and mixed nature, "encore ces rapports zoologiques sont-ils d'une nature assez equivoque et assez mélangée."§

* See 'Transactions of the Geological Society of London,' 4to, vol. i, 2d ser., pt. 2, 1824.

† 'Ossemens Fossiles,' 4to, vol. v, pt. 2, p. 343.

‡ 'Geological Transactions,' vol. i, 2d ser., p. 427.

§ Tom. cit., p. 345.

This side-blow to Dr. Buckland's determination has been repeated by later foreign palæontologists. M. Deslongchamps, for example, has remarked, "Qu'il n'y a de bien décidément constaté, comme *Megalosaurus*, que les dents; car les autres pièces osseuses, que l'on rattache à ce genre, y concordent à la vérité par la taille et parce qu'elles ont été trouvée dans les mêmes bancs, mais non dans le même bloc."* The *Megalosaurus*, in fact, was not the only gigantic reptile which the Stonesfield slate was then known to have contained; but, up to the present time, it has been the sole representative of the Dinosaurian order in that formation; and the combination of the characteristic modifications of the sacrum, scapular arch, and great limb-bones, in skeletons of the same individual of the *Iguanodon*, and equally proved to coexist in the *Hylæosaurus*, has added greatly to the probability of the disjoined complex sacrum, dorsal, and lumbar vertebræ, coracoid, and the large hollow femur, from the Stonesfield slate, which, though Dinosaurian, were neither *Iguanodontal* nor *Hylæosaurian*, having belonged to a distinct species of great Dinosaur: to no other reptile, indeed, could the portion of jaw, with teeth manifesting in their structure and mode of implantation the same transitional or annectant characters between the *Crocodylia* and *Lacertilia* as the above-cited parts of the skeleton present, be, with greater probability, referred, than to the peculiar Dinosaurian Carnivore to which the parts of the skeleton above defined certainly belonged.

To my own mind the above reasoning, strengthened by repeated instances of the occurrence of *Megalosaurian* teeth, with vertebræ, sacrum or portions of sacrum, coracoids, and femora, of the same species as those from Stonesfield ascribed to *Megalosaurus*, in Wealden and Oolitic formations of other localities, has produced a conviction that the parts to be described in the present Monograph do belong to one and the same species.

There is, moreover, a peculiar smoothness of surface and compactness of exterior osseous layers, common to the portions of toothed jaws with the other parts of the skeleton, that immediately suggest to the practised anatomical eye the idea of their being specifically identical. The microscopic character of the osseous tissue from the above-named bones is also the same; but on this evidence I should not lay much stress, since the difference is not, at least to me, appreciable between the *Megalosaurus*, *Poikilopleuron*, and *Streptospondylus*, in regard to the microscopic characters of the bone.

The bodies of the sacral vertebræ, as the five vertebræ of the *Megalosaurus* first discovered have proved to be,† are remarkable for their median constriction, and the almost cylindrical form of the transverse section of that part; and the repetition of these and some minor characters in vertebræ of the same size from other parts of the trunk, as, *e.g.*, in a detached dorsal and caudal vertebra obtained from Stonesfield

* 'Sur le *Poikilopleuron* Bucklandi,' 4to, p. 52.

† Report on British Fossil Reptiles, Part II, 'Trans. of the British Association,' 1841, p. 105.

with the original series of Megalosaurian remains, have sufficed for the determination of subsequently discovered and better-preserved specimens of detached vertebræ of the *Megalosaurus* from other localities.

Dorsal vertebræ.

The *Megalosaurus* departs, perhaps even more than does the *Iguanodon*, from the existing Crocodiles, Monitors and Lizards, in its vertebral characters. The articulating surfaces of the vertebral bodies are very slightly concave, indeed almost flat, presenting in that respect the type of the Amphicælian Crocodiles: the non-articular surface is remarkably smooth and polished. The centrum is much contracted in the middle, presenting a deep concave outline of the under surface: the margins of the expanded articular extremities are thick and rounded off. The almost cylindrical section of the middle part of the vertebra arises from its being nipped in, as it were, by a more or less deep longitudinal fossa on each side, just below the base of the neural arch; the centrum, however, slightly expanding above the fossa to support the arch.

The length of the base of the neurapophysis is nearly equal to that of the centrum; the suture is persistent, as in Crocodiles; its course is undulating, and it rises in the middle of the centrum. The neurapophysis ascends and inclines outwards, to form, at a height above the centrum equal to three fourths its vertical diameter, the margin of a broad platform of bone, from the sides of which the upper transverse processes (diapophyses) are developed, and from the middle of the upper surface the spinous process. A recent discovery has shown the extraordinary development of the latter apophysis in some of the anterior dorsal vertebræ.

In the Wealden deposits at Battle, Sussex, a large nodule of the ferruginous clay had been formed and consolidated around a portion of the skeleton of a *Megalosaurus* consisting of some anterior thoracic vertebræ. In the state in which this nodule was submitted to my examination, three almost entire and consecutive vertebræ, wanting the ribs, were preserved in natural juxtaposition. A figure of this unique specimen, discovered by S. H. Beccles, Esq., F.G.S., was, with his kind permission, given in a preceding Monograph.* In a second portion of the same nodule two almost entire and consecutive ribs of the right side were preserved: a smaller fragment contained the bodies and neural arches of two consecutive vertebræ in natural junction from a more anterior part of the chest than the series of the three vertebræ (*loc. cit.*, pl. xix). Two detached vertebræ, wanting the spinous process, from a hinder portion of the trunk, had been obtained either from, or near to, the above-described large nodule.

* 'Palæontographical Society,' 1855, t. 19.

The three vertebræ (*loc. cit.*, tab. xix) retain, what is rarely preserved in such complex parts of fossil Saurians, the entire neural spines, *ns*, and exhibit a disposition and proportions of those parts which have not before been noticed in any Dinosaurian, or in the dorsal vertebræ of any other reptile, recent or fossil.

That these vertebræ are from the fore part of the chest is indicated, according to the analogy of the *Crocodylia* and of the *Iguanodon*, by the articular surfaces for both the head and tubercle of the rib, and by the progressive ascent of the surface, *p*, for the head of the rib, as the vertebræ recede in position. By reference to the T. XIX, in the previous Monograph, *loc. cit.*, it will be seen that this surface slightly projects, and is situated upon the neurapophysial suture in the first, *p, ns*, but above that suture, supported wholly by the neurapophysis, in the third of those vertebræ, *p, ns'*. The megalosaurian character of all of the vertebræ is shown by the great, though regular and gradual constriction of the centrum between its articular ends, by the corresponding depth of the concave contour lengthwise, and by the almost circular form of the transverse section of the lower two thirds of the centrum. The non-articular surface of the centrum is smooth and polished, with some longitudinal grooves and ridges near the expanded ends, the bodies of which are thick and rounded. The side of the centrum is moderately hollowed below the neural suture, and swells out, becoming convex vertically, before bending round to the under surface. There is a rough tuberosity, *t*, at the upper and back part of the centrum, which may be contributed by the base of the neurapophysis.

The neural arch offers the same complex structure as in other *Dinosauria*: a compressed plate, *b*, extends obliquely backward from the parapophysis, *p*, to the diapophysis, *d*; the latter being supported by a stronger buttress extending outward from near the back part of the base of the neurapophysis, and being slightly inclined forward. Three deep depressions, probably receiving parts of the lungs in the living animal, divide these lamelliform buttresses from each other, and from the bases of the anterior, *z*, and posterior, *z'*, zygapophyses. The articular surface of the anterior one looks upward and slightly inward, that of the other, *z'*, downward and slightly outward, both being nearly horizontal. The neural platform extends from the outer margin of the prezygapophyses, *z*, to the fore part of the postzygapophyses, *z'*. The back part of the base of the neural spine is formed by two strong ridges, continued each from the whole upper part of the postzygapophysis, leaving an intermediate fossa for the implantation of a ligament: the base extends forward to the interspace between the prezygapophyses, being coextensive lengthwise with the vertebral centrum.

In the anterior of the three vertebræ the spine, *ns*, as it rises, slightly decreases in fore-and-aft extent, and then as gradually regains its dimension in that direction: after contracting transversely to a thickness of eight lines, when two inches above its base, it gradually expands to a thickness of one inch and a half at its summit, which forms a rough tuberosity, bevelled off obliquely from before upward and backward

to within a third of its hinder border, which is flat: the whole height of this spine is nine inches, the vertical extent of the entire vertebra being thirteen inches six lines. The spine of the second vertebra, *ns*, 1, has a similar size and shape in the basal third of its extent, but it expands more gradually, especially transversely, and rises to a greater height, continuing to expand in every direction, but especially in the antero-posterior one; the fore part of its thick extremity being produced so as to overlap the horizontal part of the end of the shorter spine in front. The sides of the thick expanded end of this clavate spine are impressed by irregular decussating ridges, indicative of the attachment of strong tendons or ligaments; and, from the back part of the side, six inches below the summit, there projects a tuberosity: a less prominent tuberosity forms the border of the overlapping anterior part of the clavate end of the spine. The whole length of the spine is 13 inches 6 lines; the vertical extent of the entire vertebra being 18 inches 6 lines.

The neural spine of the third vertebra, *ns*'', is somewhat smaller than the foregoing at its most contracted part, three inches above its origin; but it expands, as it rises, attains a height of 14 inches, and is divided, like the foregoing, into a smooth part, and a summit impressed by the attachments of the nuchal ligaments or tendons. The base of the latter part develops a tuberosity from the fore part and back part of its outer side, and there are indications of ossifications in the interspace between it and the antecedent spine, which seem to have bound them immoveably together.

The proportions and external configuration of the spines of these anterior dorsal vertebræ, the sudden increase of the second spine, the further increase of the third, with the indications of the strength of the muscles or nuchal ligaments to which their expanded tuberculate summits have given attachment,—all recall characters of the spines of the anterior thoracic vertebræ of certain great Mammalia, and much more closely resemble those parts in the tiger or rhinoceros than in the crocodile, the gavia, or in any of the known existing Lizards. But the production of the summit of the second spine, so as to overlap part of that of the first spine, and the partial ankylosis of the second with the third spine, together with the great increase in the thickness of all the spines toward their summit, are characteristics in a great measure peculiar to the present extinct Dinosaurian; unless, indeed, it participated in them with some other members of the same extinct order of reptiles.

We cannot view this remarkable configuration of the anterior thoracic vertebræ of the Megalosaurus without being impressed by an idea of the great strength of the muscles or ligaments—more probably of the energetically contracting muscles—which were implanted in those thick and lofty spines, from which, as from a fixed point, they acted upon the nuchal region of the head. The remarkable fossil, therefore, above described, yields some insight into the vigour with which such a head, consisting chiefly of the well-armed maxillary and mandibular apparatus, must have been made to operate on the bodies which the instincts of the Megalosaurus impelled it to grapple with and

destroy in the reiterated predatory or combative acts necessitated for its own support and preservation.

Several specimens of dorsal vertebræ of the *Megalosaurus*, with the spinous process broken away, have come under my observation. The largest of these, preserved in the Geological Museum at Oxford, gives the following dimensions :

| | In. | Lines. |
|---|-----|--------|
| Length of centrum | 4 | 6 |
| Height of ditto | 4 | 3 |
| Breadth of ditto across articular surface | 3 | 9 |
| Breadth of ditto across the middle part | 2 | 6 |

The proportions and configuration of the neural arch agree with those of the more perfect vertebræ from the Wealden at Battle. The height of the spinous process of this vertebra, according to that marked *ns''* in T. XIX, *loc. cit.*, would not be less than 18 inches.

The upper part of the centrum is impressed by the spinal canal, which expands at each end, but chiefly behind. One or two vascular canals are sometimes present at the under part of the centrum, but are neither so large nor so regular as in the *Plesiosaurs*.

Compared with the *Iguanodon* (see T. XXXV, of 'Monograph on the Fossil Reptilia of the Cretaceous Formations,' Palæontographical Society, 1854), the sculptured sides of the neural arch are lower in proportion to their length in the *Megalosaurus*: the anterior zygapophyses are more produced and more angular; the posterior ones are less produced. The depression anterior to the buttress, *a*, is bounded by the converging buttress or ridge, *b*, but this seems not to have been developed in the *Iguanodon*, in which the nearest approach to it is the elevated parapophysis in certain vertebræ, as in that figured in T. XXXV, *p.* There does not appear to have been, in the *Iguanodon*, the depression answering to that in front of the buttress, *b*, in T. XIX.

It would seem, from the mutilated lumbar vertebræ of the *Megalosaurus* in the Oxford Museum, figured in Dr. Buckland's original Memoir, pl. xlii, fig. 2, that the anterior oblique buttress, *b*, subsided in the vertebræ in that region.

Sacral vertebræ. Tab^{es}. I, II, and III.

The sacrum of the *Megalosaurus* (T. I) consists of five anchylosed vertebræ, and it is remarkable, considering how small a proportion of the recognisable bones of this rare reptile has been found, that the present characteristic part of the vertebral column of three different individuals should have been obtained: one sacrum, from Stonesfield, is in the Geological Museum at Oxford; a second sacrum, from Dry

Sandford, is in the Museum of the Geological Society; and a portion of a third sacrum (T. II and III), from the Wealden formation, is in the British Museum.

I have studied each of these specimens with much attention, which a recognition of their remarkable structure has well repaid.

It would seem that Cuvier did not regard the five anchylosed vertebræ, figured in Dr. Buckland's original Memoir,* as the sacrum of the Megalosaurus. They are briefly alluded to in the second and fourth editions of the 'Ossements Fossiles,' and in the description of the Plate (249, ed. iv, 1836), in which Dr. Buckland's figure is reproduced as a "Suite de cinq vertèbres de Mégalosaurus" (p. 23). In truth, the sacrum was not known to be represented, at that time, in any Saurian by more than two vertebræ, and therefore Dr. Buckland mentions this part in his original Memoir as "five anchylosed joints of the vertebral column, including the two sacral and two others, which are probably referable to the lumbar and caudal vertebræ."†

In contemplating this series of five anchylosed vertebræ, so new in Saurian anatomy, at the period of preparing, in 1840, the 'Report on British Fossil Reptiles,' for the British Association, my attention was first arrested by the singular position of the foramina (T. I, *f, f, f*) for the transmission of the nerves from the inclosed spinal marrow. These holes, which, in the plate illustrating Dr. Buckland's important Memoir, are represented above the bodies of the three middle vertebræ, are natural and are accurately given; the smooth external surface of the side of the vertebra may be traced continuing uninterruptedly through these foramina, over the middle, or nearly the middle, of the centrum, into the surface of the spinal canal.

But the normal position of these foramina throughout the vertebral column in all existing Saurians is at the interspace of two vertebræ, whence by French anatomists these holes are termed "trous du conjugaison." In the sacrum of the Oxford Megalosaur, however, it is evident that above the anchylosed intervertebral space, *i*, a thick and strong imperforate mass of bone, *p*, *d*, ascends to the neural platform, *d*, leaving it to be conjectured either that the nerve had perforated the middle of the neurapophysis, or that these vertebral elements had undergone in this region of the spine a change in their usual relative position to the centrum.

Previous researches into the composition and modifications of the vertebræ in the different classes of Vertebrata soon enabled me to recognise the peculiar condition and analogies of the five anchylosed vertebræ of the Megalosaurus; with a view to illustrate which, I shall premise a few observations, on the different relative positions which the peripheral vertebral elements may take, in regard to the central part or body. The lateral vertebral elements, pleurapophyses, or "vertebral ribs," the inferior laminæ or hæmapophyses, the superior laminæ or neurapophyses, are all subject to such changes; but the neurapophyses are much more constant in their place of attachment than the

* 'Transactions of the Geological Society,' 2d ser., vol. i, pl. 42.

† *Ib.*, p. 395.

other elements. In Mammals the ribs for the most part are joined to the interspace of two centrams; in reptiles each pair is attached to a single centrum. In fishes, and the Mosasaur among reptiles, the hæmapophyses depend, each pair from its proper centrum: in most other reptiles and mammals they are articulated to the interspace of two vertebræ, leaving a half-impression on each of the contiguous centrams. The neurapophyses present a degree of constancy in their relation to the body of the vertebra corresponding with the importance of their function. In Mammals I know of no exception to the rule, that each neural arch is supported by a single centrum: among reptiles the Chelonia* offer in those vertebræ in which the expanded spinous processes contribute to form the carapace, the interesting modification analogous to those noticed in the lateral and inferior vertebral elements, viz., a shifting of the neurapophyses from the middle of the body to the interspace of two adjoining centrams, whereby that part of the spine subject to greatest pressure is more securely locked together, and a slight yielding or elastic property is superadded to the support of the neural arch.

The same modification is introduced into the long sacrum of birds;† each neural arch is there supported by two contiguous vertebræ, the interspace of which is opposite the middle of the base of the arch above, and the nervous foramen is opposite the middle of each centrum. It is this structure, beautifully exemplified in the sacrum of the young ostrich, which Creative Wisdom adopted to give due strength to the corresponding region of the spine of a gigantic Saurian species, whose mission in this planet had ended probably before that of the ostrich had begun.

The anchylosed bodies of the sacral vertebræ of the Megalosaur retain the distinguishing characters which have been recognised in the dorsal and caudal vertebræ, in regard to the smooth and polished surface of their middle constricted part; the cylindrical, or nearly cylindrical transverse contour of this part below the lateral depression, *c*; their expanded, thickened, and rounded articular margins, *i*; and also, though in a somewhat less degree, their relative length as compared with their breadth and height. The three anterior sacrals, T. I, 1, 2, 3, are, however, somewhat shorter than the two posterior ones, 4 and 5.

The following are the dimensions of the fifth sacral vertebra:

| | In. | Lines. |
|--|-----|--------|
| Antero-posterior diameter of centrum | 4 | 10 |
| Vertical diameter of articular and of centrum | 4 | 1 |
| Transverse diameter of the same part | 4 | 6 |
| Vertical diameter of the middle of the centrum | 2 | 6 |
| Total height of the fourth sacral vertebra | 11 | 0 |

* Cuvier describes the exceptional structure above alluded to in these reptiles, and likewise cites the Chondropterygians, 'Leçons d'Anat. Comparée,' ed. 1836, tom. i, p. 213.

† 'On the Nature of Limbs,' 8vo, 1849, p. 61, fig. 10.

The neural arches of the first three sacral vertebræ, *ns* 1, 2, 3, have been advanced so as to rest directly over the interspaces of the subjacent bodies; that of the fourth, *ns* 4, derives a greater proportion of its support from its proper centrum, *c* 4; and that of the fifth, which rests by its anterior extremity on a small proportion of the fourth centrum, is extended over nearly the whole length of its own centrum, so that in the caudal vertebræ the ordinary relations of the neural arch and centrum are again resumed. In the first four sacral vertebræ the base of the neural arch extends half way down the interspace between the bodies, and immediately develops from its outer part a strong and short transverse process, or parapophysis, *p*, which is broken and rounded off in the fossil. From the base of this process the neurapophysis expands upward, forward, and backward, is joined by vertical suture to similar expansions of the contiguous neurapophyses, and terminates above in a ridge of bone, *d*, *d*, at right angles to the suture; this ridge, with those of the other neurapophyses, extends longitudinally above the parapophyses the whole length of the sacrum, and forms the margin of the platform from which the spinous and accessory processes are developed: in the last sacrum the corresponding part forms a thick, obtuse process, or diapophysis *d*, 5. The platform is further supported by a compressed ridge of bone extended from the upper part of the parapophyses, like a buttress, to the middle of the horizontal ridge. On each side of the buttress there is a depression, which is deepest in front. The spinous process is not developed, as in the dorsal vertebræ, immediately from the platform, but a shorter, vertical plate of bone, a metapophyses, *m*, of nearly the same longitudinal extent as the true spine, is developed on each side of, and parallel with its base; the height of these metapophyses in the third sacral vertebra is three inches and a half; they incline obliquely outwards, like the metapophyses in the dorso-lumbar vertebræ of the armadillos, and evidently tend to strengthen the connection between the sacral part of the trunk, and the pelvic base of articulation of the hind limbs. The spinous process begins to expand longitudinally, and when nearly opposite the summit of the metapophyses, is joined by vertical suture with the similarly expanded neighbouring spines, so that the sacrum is crowned by a strong continuous vertical longitudinal ridge of bone, at least along the first four vertebræ; the broad spine of the fifth being rounded off anteriorly, and separated by a narrow interspace from that of the fourth. Besides this modification of the spine, and the more normal position of the neural arch, the diapophysis, *d*, of the fifth anchylosed vertebra, resumes its more ordinary shape, and it is supported by two converging ridges of bone from the side of the neural arch below. The origin of the metapophysis, *p*, of the first sacral is placed higher than in the three middle ones, in which the several peculiarities of structure above described are most strongly marked.

The specimens of sacrum of the *Megalosaurus* in the British Museum, and that of the Geological Society, present the same structure as that above described in the original specimen at Oxford. Part of the fifth sacral vertebra is wanting in the

specimen from Dry Sandford. The remaining vertebræ in this specimen are characterised by the same smooth and polished surface, rich brown colour, contraction of the middle of the body, its cylindrical form transversely, and the longitudinal fossa below the annular part, as in the Oxford specimen. The length of this series is one foot six inches and a half; the second and third sacral vertebræ are rather shorter than the rest. The first sacral vertebra, which was not anchylosed to the last lumbar, gives the following dimensions:—

| | In. | Lines. |
|---|-----|--------|
| Antero-posterior diameter of centrum | 5 | 0 |
| Vertical diameter of anterior articular end | 4 | 0 |
| Transverse diameter of anterior articular end | 4 | 6 |

The neural arch seems not to have been coextensive in length with the centrum, but rests on its anterior three fourths. A strong and short parapophysis extends obliquely upwards and backwards from each side of the arch; the antero-posterior diameter of the base of this process is two inches, its vertical diameter one inch and a half. In the second sacral vertebra the neural arch has moved forward upon the interspace between the first and second sacral bodies, and develops from the lower part of its base a stronger, thicker, and longer parapophysis, directed outwards and forwards. The third neural arch has its base transferred directly over the interspace of the second and third centra; the diameters of the base of its parapophyses are three inches and two and a half inches: they incline slightly backwards. The fourth neural arch descends lower down upon the interspace between the third and fourth centra. The fifth neural arch, as in the Oxford specimen, extends a little way across the interspace between the fourth and fifth centra, but nearly resumes its ordinary place. The second and third sacral vertebræ are not so regularly convex below in the transverse direction, but their sides converge so as to give a slight indication of a broad obtuse ridge. The diameter of the spinal canal in the first and last sacral vertebræ is one inch.

T. II gives a side view of one of the sacral vertebræ, and a great proportion of the next vertebra, of the natural size, from the specimen of a portion of the sacrum of the *Megalosaurus* in the British Museum. The characteristic shape of the bodies of these vertebræ is better shown in the view of their inferior surface, T. III. But, in one of the vertebræ, s 3, the transversely rounded or convex surface begins to be modified into an almost carinate form of that surface. A similar difference of the inferior surface may be noticed in the third and fourth sacral vertebræ of the *Iguanodon*.*

The terminal articular surface of the last sacral vertebra, which articulates with the first of the caudal series, is shown in fig. 2, T. III.

* Palæontographical Society, 1854, 'Wealden Dinosauria,' Tab. III.

The five sacral vertebræ are not anchylosed in a straight line, but describe a gentle curve, with the concavity downwards; the series of parapophyses, or sacral ribs, forms a curved line in the opposite direction, in consequence of their different positions in the several vertebræ. The summits of the anchylosed spines being truncated, describe a curve almost parallel with that of the under part of the vertebræ.

The contour of the hinder part of the body of the present gigantic carnivorous Lizard, doubtless raised high above the ground upon the long and strong hind-legs, must have been different from that of any existing Saurians. In these the relatively shorter hind-legs, being directed more or less obliquely outwards, do not raise the under surface of the abdomen from the ground; it is the greater share in the support of the trunk assigned to the hind-legs in the *Megalosaur* which made it requisite that, as in the *Iguanodon* and in land mammals, a greater proportion of the spine should be anchylosed to transfer the superincumbent weight through the medium of the iliac bones upon the femora.

In the caudal vertebræ the parapophyses are suppressed, and the single transverse process is formed by the diapophysis being lengthened out by the anchylosed rudiment of a rib. The hæmal arch was articulated to the lower part of the vertebral interspaces, but chiefly to the anterior vertebra.

Ribs. Tab. IV.

The ribs which, from their size, texture, and colour, as well as from their proximity in the matrix to other more characteristic parts of the *Megalosaurus*, belong most probably to the same species of reptile as the vertebræ above described, present a double articulation with the vertebral column.

The specimen, fig. 1, from the Stonesfield Oolite, and now preserved in the Museum at Oxford, has a small, almost flattened, obtuse head, *c*, for articulation with a parapophysis; the neck is long, and soon begins rapidly to increase in vertical thickness, being strengthened, also, by a longitudinal ridge on one side. It develops a thick, obtuse tubercle, *t*, larger than the head, for the diapophysis. The body of the rib gradually contracts, with a slight curve, to a point. The length of the body of this floating rib, is little more than twice that of the neck and tubercle, showing that it must have belonged to a hinder cervical or anterior dorsal vertebra.

A second specimen, fig. 2, from the Stonesfield slate, shows a longer body, a neck set on more transversely, and less expanded beneath the tubercle. The upper margin of the neck is sharp; the body of the rib is strengthened by a lateral ridge, and becomes compressed in such a direction that those ridges form its margins towards the lower end; this terminates so as to indicate its having been joined to an abdominal rib.

The upper portion of a rib from a larger specimen of *Megalosaurus*, and from a more expanded part of the thoracic abdominal cavity, T. IV, fig. 3, formed, with fig. 1, part of the original series of fossil bones, from the Stonesfield slate, de-

scribed and referred to the *Megalosaurus* by Dr. Buckland.* It is remarkable, like the corresponding ribs of the *Iguanodon*,† for the length and strength of the part between the head, *c*, and tubercle, *t*, called the “neck;” but this presents a different form in transverse section, and a different direction from the neck of the rib in the *Iguanodon*. The outer border of the body of the rib does not expand below the tubercle, *t*, to form the shield-like plate which characterises the larger ribs of the *Iguanodon*;‡ the entire body of the rib is more slender, or narrower, but is, perhaps, stronger, from being less flattened and more quadrate, in transverse section; it is strengthened by two low lateral ridges. The relative thickness of the dense, compact outer wall of the rib, to the more open cancellous structure of the central part, which forms what might almost be termed a medullary cavity, near the middle of the body of the rib; and the form of the transverse section of the cervix and body of the rib, are shown in T. IV, fig. 3.

Cuvier, in his explanation of the figures introduced into the ‘*Ossemens Fossiles*,’ from the original Memoir of Buckland, describes three of the ribs, in the fourth edition (8vo, p. 93) as belonging to “un saurien voisin des crocodiles.” It is, in fact, only in the Crocodilian order amongst existing reptiles, that the ribs present a head, neck, and tubercle, coincident with that two-fold articulation with the rest of the vertebra which is associated in the Crocodiles and Gavials with a higher grade of structure of both heart and lungs. The ribs, however, found associated with other parts of the skeleton, including a tooth of the *Iguanodon*, in the Maidstone quarry of Kentish rag-stone,§ demonstrated that the Crocodilian type of rib was associated with the Dinosaurian modifications of sacrum and limbs in that gigantic reptile: and there can be no reasonable doubt that the like association characterises the skeleton of the *Megalosaurus*. The minor modifications, above specified, of the huge ribs and fragments of ribs found with portions of jaw, limb-bones, and complex sacrum of answerable magnitude, in the same Oolitic stratum in Oxfordshire relate only to the generic distinctions of the *Megalosaurus*, as compared with the *Iguanodon*.

The scapula. Tab. V.

In the Wealden deposits at Stammerham, Sussex, a scapula of the Dinosaurian type, but differing from the known scapulæ of the *Iguanodon* and *Hylæosaurus*, has been discovered by G. B. Holmes, Esq., of the neighbouring town of Horsham, by whom I have been favoured with the drawing lithographed in T. V.

As remains of the *Megalosaurus* have been obtained from the same locality, some of

* Tom. cit., pl. 43, fig. 1.

† Palæontographical Society, ‘Monograph of Wealden Reptiles,’ No. 2, 1854, Tab. II.

‡ Tab. cit., figs. 1 and 2.

§ ‘Palæontographical Memoirs,’ 1851, Tab. .

which form part of Mr. Holmes's instructive collection, it is possible that the blade-bone in question may belong to that genus; but I insert the description of it here with a full sense of the inadequacy of our present evidence for the precise determination of the scapula of the *Megalosaurus*.

The body of the bone is an oblong flattened plate, proportionally broader and shorter than in the *Iguanodon*; with the base rounded, not truncate as in the *Hylæosaurus*; and with the anterior border at first, as it descends, straight and then concave, not convex, as in the *Hylæosaurus*. The body of the scapula slightly decreases in breadth as it approaches the articular end, near which there is continued from the anterior border a long and slender process, at least three fourths the length of the entire bone, but the precise proportions of which cannot be determined in this specimen, because the extremity of the process is broken off. Near the base of the process a tuberos projection is developed, which touches the anterior angle of the articular end of the scapula, circumscribing an elliptical vacuity probably for the transmission of vessels. The thickened articular extremity shows indications of a division into two surfaces, one for the coracoid, the other for the humerus.

The coracoid. Tab. VI.

The coracoid is a long and large semioval plate of bone, 2 feet 6 inches in length, 1 foot 4 inches in greatest breadth; with the inner (mesial) border thin and regularly but very slightly convex, the upper border thin and strongly convex, the outer (lateral) border thick and made irregular by the development of processes, grooves, and articular surfaces. The latter are two in number: the largest and deepest, fig. 1, *o, l*, for the head of the humerus, the smallest and shallowest, *o, o*, for junction with the scapula.

This surface, which is hollowed out, groove-wise, chiefly in one direction, is supported by a very strong, thick, three-sided process, *n, o*, a little expanded towards its free end, and contributing by its hinder surface, *o'* to the formation of the glenoid cavity, in front of which it projects to meet the blade-bone. The length of this process is about 6 inches: its circumference is 13 inches; the length of the scapular articular surface, fig. 2, *o*, is 6 inches. A deep oblique notch, fig. 1, *n*, divides the scapular process, *o*, from the thin anterior part of the coracoid, *c, s*, the convex border of which is entire.

In some existing Lacertians, *e, g*, the Monitor and Iguana, a second process is sent off from this part, for articulation through the medium of an epicoracoid cartilage with the episternum; and the mutilated state of the first-discovered specimen of coracoid of the *Megalosaurus*, figured by Dr. Buckland in pl. xliii, fig. 3, vol. i, 2d series of the

‘Geological Transactions,’ produced a similar appearance, and led to the belief that the Megalosaurus resembled those Lacertians, in having both the scapular and episternal processes of the coracoid.

Not fewer than three entire or almost entire coracoids of the Megalosaurus have since been obtained, and are now in the British Museum, two of which show the true contour of the anterior part of the bone, as represented in T. VI, fig. 1, *e, s.* The Megalosaurus, therefore, resembled the Scincoid Lizards and the Crocodiles, in having only the scapular process in its coracoid; approaching, however, to those Lizards and the Lacertians generally in the great breadth of the bone, but more resembling the Crocodiles in the greater development of the scapular process as compared with that in the Scincoids. The glenoid cavity of the coracoid of the Megalosaurus, T. VI, fig. 2, *m*, is deeper and larger than in recent Saurians, or than in the Iguanodon. The longitudinal diameter of its outlet is 8 inches in the largest of the three coracoids (purchased by the British Museum of Mr. Stone, from Stonesfield); the greatest transverse diameter of the cavity is 4 inches 4 lines: the internal (central) border of the cavity is moderately sharp and entire; the external (peripheral) border becomes thicker as it recedes from the scapular process, and ends abruptly in an oblong tuberosity; the rest of the outer border beyond this part is thick and rounded, and is continued upon the obtuse process, *l*, forming the hinder boundary of the cavity. This process projects beyond the sharp, almost straight, outer border of the hinder part of the coracoid, which terminates in the hinder angle of the bone.

A strong ridge, like the spine of a scapula, begins to rise from the outer surface of the coracoid, about four inches behind the tubercular termination of the fore and outer part of the glenoid border: it is, at first, thick and rounded, but gradually becomes thinner and more prominent, and is bent outwards and backwards, rapidly subsiding near the hinder angle of the coracoid, and forming the external wall of a wide and deep groove; the internal wall of which is formed by the proper outer and hinder border of the coracoid, fig. 2, *l*. The large proportion of the exterior surface of the coracoid between this process and the anterior border of the bone is slightly concave; the opposite or inner surface being in a less degree convex, or nearly flat. Except a low thick ridge extending from within about four inches of the glenoid cavity to near the lower angle, enlarging as it approaches thereto, the inner surface, fig. 1, is even and almost smooth. Coarse striæ radiate from the articular part of the coracoid to its free expanded border. There is no foramen in any part of the coracoid; none certainly at the base of the scapular process or between this and the glenoid cavity, where such perforation, Cuvier states, may be found in all existing Lizards. If the scapula, T. V, above described should actually belong to the Megalosaurus, the notch or foramen at *e*, fig. 1, may fulfil the function of that which, in the Iguanodon, exists in the coracoid itself.

The clavicle. Tab. IV, fig. 4.

A slender sigmoid bone, nearly two feet in length, from the Stonesfield slate, now in the Geological Museum at Oxford, T. IV, fig. 4, was referred, by the discoverer of the *Megalosaurus*, to that species,* from its resemblance to the clavicle in certain Lizards, especially, as Cuvier remarks, who concurs in this determination with Buckland, to the clavicle of the great scincoid Lizard.† It is, however, less bent upon itself than in that existing Saurian, and bears a closer resemblance to the clavicle of the *Iguanodon*.‡ The more expanded median or pectoral extremity of the bone in question has one margin fractured, that which corresponds with the margin from which the two processes are developed in the clavicle of the *Iguanodon*: how far, therefore, the *Megalosaurus* resembled the *Iguanodon* in the form or even existence of those processes cannot at present be determined. The shaft of the clavicle presents a similar gentle sigmoid curve, but is relatively thicker and more bent than in the *Iguanodon*; its transverse section is subtriangular: the outer or scapular end is more expanded; the sternal end is more rounded or convex. With respect to the present bone, Cuvier has remarked that according to the proportions of the clavicle in existing Lizards, it bespeaks an animal nearly sixty feet in length,§ but the proportions of the trunk to the limb-bones alter with the increasing bulk in different species of the same family or order, and we shall presently show that there are surer grounds for arriving at the true bulk of the *Megalosaurus*, than the comparison of its limb-bones with those the small existing Lizards affords.

The ischium. Tab. IV, fig. 5.

The subcompressed, three-sided bone, flattened and expanded at one end, thickened and less expanded at the opposite end, which formed part of a large cotyloid cavity, has most claims to be regarded as the ischium of the *Megalosaurus*. This bone, now in the Geological Museum at Oxford, formed part of the original series obtained from the Oolitic slate at Stonesfield, and described by Dr. Buckland.||

The longest diameter of the bone is 18 inches; the breadth of the almost straight, thin, mesial border, is about 14 inches, but the angles are somewhat mutilated; the narrow even flattened surface of this border appears to have joined, probably with some interposed fibro-cartilaginous matter, to the corresponding margin of the opposite ischium.

* Buckland, loc. cit., pl. 44, figs. 3 and 4.

† 'Ossements Fossiles,' 4to, tom. v. pt. ii, p. 347.

‡ Palæontographical Society, vol. for 1851, 'Reptilia of the Chalk,' Tab. XXXIII; and vol. for 1854, p. 33.

§ 'Ossements Fossiles,' p. 348.

|| Loc. cit., p. 427, pl. 43, fig. 4.

The femur. Tabs. VII and VIII.

The fine specimen of this bone, 32 inches in length, of which two views are given in T. VII, was discovered in the Oolitic slate at Stonesfield, originally formed part of the rich collection of Fossil Remains belonging to the Earl of Enniskillen, F.R.S., and has recently been transferred, with other parts of the *Megalosaurus*, from the same collection to the British Museum.

The head is subhemispheric, with the lower margin more freely projecting over or beyond the under part of the neck than appears to have been the case in the *Iguanodon*.* Viewed from behind, as in fig. 1, or in front, the head of the femur appears to be the convex termination or production of the somewhat expanded and posteriorly flattened upper end of the shaft; but, viewed from the inner side, where the great trochanter, *c*, is seen relieved from the shaft of the bone, the head of the femur has the appearance of being supported by a long and oblique neck, more slender than the shaft. The great trochanter is broad but not much produced, being, as it were, somewhat crushed down upon the shaft. The well-marked groove defining its upper part from the neck, reminds one of that which defines the same part of the upper trochanter in the *Iguanodon*; but the fissure is narrower and deeper in that *Dinosaur* than in the present genus. The inner trochanter, T. VII, *d*, is situated higher up, and is less produced than in the *Iguanodon*: it has also a broader base, which is extended further upon the hinder surface of the shaft of the femur. I have not seen any femora of the *Megalosaurus* in which the two trochanters were so nearly opposite one another, as is represented in the figures of that bone given in Dr. Buckland's original Memoir: the upper end of the specimen from which that figure was taken, had been more mutilated than in the original of the figures in T. VII. Below the inner trochanter the shaft of the femur assumes a subquadrate transverse section, with the angles rounded; and, near the lower end, begins to expand into the condyles. The anterior or rotular interspace, T. VIII, *g*, is much less deep, and is broader than in the *Iguanodon*; the posterior or popliteal interspace, *ib. h*, more resembles in size and depth that in the *Iguanodon*, but it is more flattened at the bottom. The outer condyle, fig. 1, *f*, has a moderately deep and wide longitudinal impression externally, which marks off the hinder projecting part of the condyle, which is relatively narrower than in the *Iguanodon*; the inner condyle, *e*, which is the largest and most prominent of the two, is almost flat upon its inner side. The figure, of the natural size, of the distal condyles, in T. VIII, taken from the best preserved specimen of the femur of the *Megalosaurus* in the British Museum will serve better than verbal description to convey a just idea of the modifications of this articular end of the bone in question.

* See T. XV, 'Monogr. Wealden Reptilia,' 1854, fig. 1.

The Tibia. Tab. IX.

The specimen, from which the reduced figures have been taken in the above plate, is the most perfect one of the tibia of the *Megalosaurus* which has hitherto come under my notice : it originally formed part of the collection of Megalosaurian remains from the Stonesfield slate, acquired by the Earl of Enniskillen, whilst an undergraduate at Oxford, and is now in the British Museum.

Fig. 1 gives a side view of the bone, with a top view of the upper articular surface. The divisions corresponding with the condyles of the femur project from the back part of the proximal end, which gradually contracts towards the fore-part where it assumes the character of a process, answering to the procnemial ridge in the tibia of birds, but it is a little inclined inward. The articular surface is a little concave at its middle part and becomes convex, in a moderate degree, upon the condyles. A thick cartilage appears to have covered the whole of this surface, and the softer bone in contact with the cartilage has been, as in most fossil reptilian long bones, more or less abraded, especially at the margins of the articulation. The backward position and production of the corresponding articular prominences or condyles in both femur and tibia, indicate that these bones were joined together at an angle, probably approaching a right one, when in their intermediate state between flexion and extension : and that motion of the tibia in the latter direction could not have taken place to the extent required to bring the two bones in the same line. A moderately developed longitudinal ridge, fig. 2, *c*, extends from the inner side of the upper fourth of the shaft of the tibia, the homologue of which is present in the tibia of the great Monitor. Below this the shaft of the tibia assumes a sub-trihedral figure, with the angles unequally rounded off, fig. 3 ; it very gradually decreases in breadth, from before backwards, to within a short distance of the lower end : the transverse diameter remains the same. The expansion of the lower articular end is chiefly in the latter direction, *i. e.*, at right angles with the long diameter of the proximal end : the inner angle of the distal end is the most produced. The form of the articular surface for the tarsus is a rhomboid, with two shallow depressions, but in the main is moderately convex.

The length of the bone above described is 26 inches : its shaft, like that of the femur, has a medullary cavity, but the compact walls are relatively thicker in the tibia.

The above-described bone, from the Oolitic slate of Stonesfield, presents all the main Dinosaurian characters, which have been described, in a preceding Monograph, in the tibia of the *Iguanodon*.* From that tibia the present bone differs in its

* Monog. cit., p. 39.

greater relative slenderness and its better developed processes, especially the inner, or entocnemial, ridge. The differences are of that degree which might be expected to be found in a limb-bone of another species or genus of large Dinosaurian reptile; and no reptile answering to that character has yet been determined, by fossil remains from the Stonesfield Oolitic slate, except the *Megalosaurus*. The modifications in question are such, moreover, as accord with the superior energy and activity which a carnivorous reptile like the *Megalosaurus* might be expected to possess in contrast with the heavier and more bulky herbivorous *Iguanodon*. There can be no reasonable doubt, therefore, that we have, in the subject of T. IX, the veritable leg-bone or tibia of the *Megalosaurus*.

Portions of metatarsal bones, most probably from their size and texture, those of the *Megalosaurus*, have been obtained from the Stonesfield Oolite and Sussex Wealden: one of these is figured by Dr. Buckland in Pl. xlix, fig. 6, of the volume of the 'Geological Transactions' containing his original Memoir on the *Megalosaurus*.

These fossils, however, which I have examined in the Geological Museum at Oxford, do not present sufficiently marked characteristic modifications to render a special description of them serviceable for the identification of future specimens of *Megalosauri*.

Ungual Phalanges. Tab. X.

Both teeth and vertebræ of the *Megalosaurus* have been discovered in the Wealden strata which contain remains of the *Iguanodon* and other large reptiles. Besides the claw-bones which, from their broad, obtuse, massive and slightly curved shape, I have referred to the herbivorous *Iguanodon*, there have been obtained, also from the Wealden, claw-bones which, by their sub-compressed, curved, and sharp-pointed shape indicate a carnivorous reptile; and some of these, by their size, might well belong to the *Megalosaurus*.

Without, however, the association of such claw-bones with other parts of the limb, recognisably *Megalosaurian*, a certain conclusion of their nature cannot be arrived at. The probability, however, of this latter type of ungual phalanx being that which the *Megalosaurus* would exhibit, decides me to give the requisite illustrations of it in the present Monograph.

T. X, figs. 1 and 2, give side views of an ungual phalanx, wanting the tip, and with a portion of matrix attached to the base. The length of this phalanx, if the point be restored according to the pattern of the smaller and better preserved specimen of the same kind, fig. 5, would be between 5 and 6 inches: the depth of the base of the phalanx is 2 inches 9 lines; the extreme breadth of the base being but 1 inch 5 lines.

The articular surface is deeply concave in the vertical direction, indicative of a strong joint and a certain extent of vertical motion, or of retraction and protrusion. Beneath the articular surface is a large rough process or protuberance for the insertion of a powerful flexor tendon. The margin of the articular pulley is slightly raised and roughened, for the attachment of the capsular ligament. The base of the claw-bone is longitudinally striated; the rest of the surface is smooth, and offers the same compact character and colour which are commonly found in the bones of the Megalosauri. On each side of the bone, nearer the lower border, and rather lower down on one side than on the other, is a deep smooth groove, running parallel with the lower concavity of the bone. These grooves indicate the position of the borders of the horny matter of the claw, and also, of the vessels supplying the reproductive matrix of that matter.

A smaller phalanx of the same type with one side imbedded in a block of Wealden sandstone, fig. 5, shows the whole length, and the sharp-pointed termination of the bone supporting the formidable claw.

Both the above-described specimens are in the British Museum.

Mandible and Teeth. Tabs. XI and XII.

The most important evidence of these highly characteristic parts of the Megalosaurus is the portion of the dentary element of the mandible or lower jaw, from the Stonesfield slate, preserved in the Geological Museum at Oxford, and forming part of the original series of bones described by Dr. Buckland.* This specimen is represented, of the natural size, in T. XI, fig. 1, from the inner side: a portion of the outer side of the same specimen is given in fig. 2. The entire depth of the ramus of the jaw is not, however, represented by this specimen: a broad and shallow groove along the under and inner surface of the bone indicates where the angular element of the mandible had articulated with this hinder portion of the dentary piece. The portion of the dentary element from a more advanced part of that bone, represented in T. XII, affords a truer idea of the vertical diameter of the mandibular ramus of the Megalosaur.

The first character which attracts the attention of the anatomist, in the Oxford specimen (T. X), is the inequality in the height of the outer and inner alveolar walls. This assures him of the saurian affinities of the gigantic reptile; a similar inequality characterising the jaws of almost all the existing Lizards. But in these the oblique groove, so bounded, to which the bases of the developed teeth are anchylosed, is much more shallow, and is relatively wider; and the teeth, in all their stages of growth,

* Loc. cit., pl. 40.

are completely exposed, when the gum has been removed. In the Megalosaur the greater relative development of the inner alveolar wall narrows the groove, and covers a greater proportion of the bases of the teeth, besides concealing more or less completely the germs of their successors. Moreover, instead of the mere shallow impressions upon the inner side of the outer alveolar plate, to which the teeth are attached in modern Lizards, there are distinct sockets formed by bony partitions connecting the outer with the inner alveolar walls in the jaw of the Megalosaurus.

These partitions rise from the outer side of the inner alveolar wall in the form of triangular vertical plates of bone, having their plane parallel with that of the inner wall; and from the middle of the outer side of each plate a bony partition crosses to the outer parapet, completing the alveoli of the fully-formed or more advanced teeth, the series of triangular plates, *t, t*, fig. 1, forming a kind of zigzag buttress along the inner side of those alveoli. The outer parapet rises an inch higher than the inner one.

Of the fully-developed teeth only one had been preserved *in situ*, in the specimen under description; the others appear rather to have slipped out, than to have been broken off, the anchylosis of the basal capsule of the tooth to the alveolar periosteum being but slight, and apparently taking place tardily in the Megalosaurus.

This tooth, T. XI, fig. 1, *a*, exhibits the average size of the fully developed teeth of the Megalosaurus that have yet been discovered. The shape of the crown is well exemplified in this figure, and in figs. 2, 4, and 5 of T. XII. It is sub-compressed, slightly recurved, sharp-edged and sharp-pointed; the edges being minutely serrated: the edge upon the convex or front border becomes blunted as it descends about two thirds of the way towards the base of the tooth; that upon the concave hinder border it is continued to the base. The lower half of the crown is thicker towards the fore-margin than towards the hind one, so that a transverse section gives a narrow oval form pointed behind, as in the lower section of fig. 5, T. XII: at the upper half of the crown the sides slope more equably from the middle thickest part to both margins, and the section is a narrow pointed ellipse, as in the upper section of the same figure. The crown is covered by a smooth and polished enamel which wholly forms the marginal serrations. The base of the tooth is coated with a smooth lighter-coloured cement, forming a thin layer, and becoming a little thicker towards the implanted end of the tooth. The remains of the pulp are converted into osteodentine in the basal part of the completely formed tooth. Moderately magnified, the surface of the enamel presents a finely wrinkled appearance. The marginal serrations present, under a somewhat higher power, the form shown in fig. 12, T. XI; their points being directed towards the apex of the tooth, a structure well adapted for dividing the tough tissues of the saurian integument. The main body of the tooth consists of dentine, of that hard, unvascular kind of which the same part of the teeth of existing Crocodiles and most mammals is composed. The dentinal tubules, in the Megalosaurus, are extremely fine and close-set, presenting a diameter of $\frac{1}{25,000}$ th of an

inch, with interspaces varying between two and three times that diameter. They radiate from the pulp-cavity at right angles with the external surface of the tooth. The primary curvatures correspond with those of the dentinal tubules in the *Varanus*, figured in my 'Odontography,' pl. 67, fig. 2; but they are less marked, so that the tubules appear straighter in the *Megalosaurus*. After their origin they dichotomize sparingly, but the number of minute secondary branches sent off into the intermediate substance is very great. These secondary branches proceed at acute angles from the primary tubules; the divisions of the latter become very frequent near the periphery of the dentine, and the terminal branches dilate into, or inosculate with, a stratum of minute calcigerous cells, which separates the dentine from the enamel.* No part of the dentine is pervaded by medullary canals, as in the *Iguanodon*.

A series of teeth from individual *Megalosauri* of different ages has been selected from specimens in the British Museum, and in the Geological Museum at Oxford, progressively diminishing in size, but preserving the same characteristic form, from fig. 4 to fig. 9, inclusive, T. XI. Fig. 3 shows a specimen, imbedded in Stonesfield slate, which shows a somewhat more slender termination than usual. Fig. 11 is a much-worn and shed tooth, apparently of a small-sized *Megalosaurus*, in which both the point and the trenchant margins had been rubbed down to a smooth obtuse surface: it may have come from the hinder part of the dental series, where the teeth may have been smaller and less sharp, or more liable to be blunted by a greater share in the imperfect act of mastication than the teeth in advance.

Successional teeth, in different stages of growth, are shown in the original portion of jaw of the *Megalosaurus* in the Oxford Museum. Some more advanced, as at *b*, fig. 1, T. XI, show their crowns projecting from alveoli already formed by the plate extending across from the triangular processes before described. Vacant sockets from which fully formed teeth have escaped occur, generally in the intervals between these more advanced teeth. The summits of less developed teeth are seen protruding, as at *c, c*, at the inner side of the basal interspaces of the triangular plate, between them and the true internal alveolar parapet. There can be no doubt that, in the course of the development of these teeth, corresponding changes take place in the jaw itself, by which new triangular plates and alveolar partitions are formed, as the old ones become absorbed, analogous to these concomitant changes in the growth and form of the teeth, alveoli, and jaws, which take place in so striking a degree in the Elephant.†

The peculiarity of the *Megalosaurus*, as compared with the Crocodiles and Lizards

* The microscopic characters of the tooth of the *Megalosaurus* are represented in my 'Odontography,' pl. 70 A, in part of a transverse section of the middle of the crown, including the pulp-cavity and its osteodentine.

† See 'Odontography,' p. 625.

which have a like endless succession of teeth, is the deeper position of the successional tooth in relation to the one it is destined to replace, and the great proportion of the tooth which is formed before it is protruded. This interesting character is well exhibited in a portion of the jaw, kindly submitted to my examination by His Grace the Duke of Marlborough, and which is figured in T. XI, fig. 1. The anterior tooth, *a*, in this specimen, shows, at the inner side of its base, the commencing absorption stimulated by the encroaching capsule of the successional tooth below, the crown of which is completed externally, though not consolidated. On one of the fractured margins of this piece of jaw a part of the basal shell of an absorbed and shed tooth remains at *a*, fig. 3, with part of the root of the successional tooth which has risen into place, *b*; but which shows its base full of matrix, the pulp not having been calcified at that period of the tooth's growth. The crown of a third tooth, *c*, incompletely calcified, is exposed beneath, in the substance of the jaw. In fig. 1, the germs of several successional teeth are shown at *c*. In the proportion of the successional teeth which is calcified in the formative cavity in the substance of the jaw, the *Megalosaurus* offers a closer resemblance to the Mammalian class than do any of the recent or extinct Crocodilian or Lacertian reptiles. But the evidence of uninterrupted and frequent succession of the teeth in the *Megalosaurus* is unequivocal, and this part of the dental economy of the great carnivorous Reptile is strictly analogous to that which governs the same system in the existing members of the class. The different forms of the teeth at different stages of protrusion did not fail to attract the attention of the gifted discoverer of the *Megalosaurus*, in whose words I will conclude this part of my Monograph on the most formidable of extinct British Reptiles.

“ In the structure of these teeth we find a combination of mechanical contrivances analogous to those which are adopted in the construction of the knife, the sabre, and the saw. When first protruded above the gum, the apex of each tooth presented a double cutting edge of serrated enamel. In this stage, its position and line of action were nearly vertical, and its form, like that of the two-edged point of a sabre, cutting equally on each side. As the tooth advanced in growth it became curved backwards in the form of a pruning-knife, and the edge of serrated enamel was continued downwards to the base of the inner and cutting side of the tooth, whilst on the outer side a similar edge descended but a short distance from the point, and the convex portion of the tooth became blunt and thick, as the back of a knife is made thick for the purpose of producing strength. The strength of the tooth was further increased by the expansion of its side. Had the serrature continued along the whole of the blunt and convex portion of the tooth, it would in this position have possessed no useful cutting power; it ceased precisely at the point beyond which it could no longer be effective. In a tooth thus formed for cutting along its concave edge, each movement of the jaw combined the power of the knife and saw; whilst the apex, in making the first incision, acted like the two-edged point of a sabre. The backward curvature of the full-grown

teeth enabled them to retain, like barbs, the prey which they had penetrated. In these adaptations we see contrivances which human ingenuity has also adopted in the preparation of various instruments of art.”*

SIZE OF THE MEGALOSAURUS.

A few words may be added touching the size of the Megalosaurus; for it appears to me that the calculations which assign to it a length of 60 and 70 feet are affected by the fallacy of concluding that the locomotive extremities bore the same proportion to, and share in the support of, the body, as they do in the small modern land Lizards.

The most probable approximation to a true notion of the actual length of the Megalosaurus is that which may be obtained by taking the length of the vertebræ as the basis. The antero-posterior dimension is the most constant which the vertebræ present throughout the spine: in most Crocodilian and Lacertian reptiles the cervical vertebræ are a little shorter than the dorsal; but these are of equal length, and the caudal vertebræ maintain the same length, though decreasing in other dimensions, to very near the extremity of the tail.

As the dorsal vertebræ of the Megalosaurus agree, in the important character of the mode of articulation of the ribs, with the Crocodiles, it may be regarded as most probable that they also corresponded in their number. This does not exceed 14 in recent Crocodiles, nor 16 in any of the known extinct species; taking, then, the latter number, and adding to it 7, the usual number of the cervical vertebræ in Crocodiles, we may allow the Megalosaurus 23 vertebræ of the trunk.

The length of the body of a large dorsal vertebra of the Megalosaurus, in the British Museum, is $4\frac{1}{2}$ inches: from the analogy of the Iguanodon I was led, in my original calculations,† to allow a probable thickness of the intervertebral substance one third of an inch: but if we multiply 23 by 5, not allowing for the probable shortness of the cervical vertebræ, we only then attain a length of 9 feet 7 inches. The subsequent discovery of the coadapted dorsal vertebræ, figured in T. xix, *loc. cit.*, shows that their bodies were not separated by soft substance of more than 1 line in thickness. If, moreover, setting aside the analogy of the Megalosaurus to the Crocodiles in the structure of the vertebræ, we take that species of Lacertian which it most resembles in the structure of the teeth, and found our calculation on the number of vertebræ of the trunk in such Lizard, then, the great carnivorous Varanian Monitor

* Buckland, ‘Bridgewater Treatise,’ vol. i, p. 237.

† Report on British Fossil Reptiles, ‘Trans. Brit. Association,’ 1841.

of Java having 27 vertebræ of the trunk, we do not, even calculating the same number of vertebræ to have occupied each a space of five inches in the Megalosaurus, obtain a length of trunk exceeding 11 feet 3 inches.

I should consider the first calculation, or about 10 feet, to have been more nearly the natural length.

To this we must add 2 feet for the known length of the sacrum. Thus 12 feet will be a fair or even a liberal allowance of length from the occiput to the beginning of the tail. In Crocodiles the skull equals about 12 dorsal vertebræ in length. In the Java Monitor the proportion of the head is less. In the Iguana the cranium does not exceed 6 dorsal vertebræ in length.

We may consider therefore 5 feet, taking the Crocodile as the term of comparison, as probably not below the length of the head of the Megalosaur. With regard to the tail, this includes between 36 and 38 vertebræ in Crocodilians, but varies from 30 to 115 in the small existing Lacertians, in many of which it is a prehensile organ, aiding them in climbing and other actions suitable to their size. It is very improbable that the tail should have presented such unusual proportions in the great Saurian under consideration, and indeed very few caudal vertebræ of the Megalosaur have been as yet discovered, and none exceeding 4 inches in length. Allowing the Megalosaur to have had the same number of vertebræ as the Crocodile, and multiplying this number 36 by $4\frac{1}{2}$, a length of 12 feet 6 inches is thus obtained for the tail. A calculation on this basis thus gives, in round numbers,—

| | Feet. |
|--|-------|
| Length of head | 5 |
| Length of trunk, with sacrum | 12 |
| Length of tail | 13 |
| Total length of the Megalosaurus | 30 |

Upon this mode of obtaining an idea of the bulk of the present extinct reptile I am disposed to place the greatest reliance, and conceive that any error in it is more likely to be on the side of exaggeration than of curtailment. From the size and form of the ribs it is evident that the trunk was broader and deeper in proportion than in modern Saurians, and it was doubtless raised from the ground upon extremities proportionally larger and especially longer, so that the general aspect of the living Megalosaur must have proportionally resembled that of the large terrestrial quadrupeds of the Mammalian class which now tread the earth, and the place of which seems to have been supplied in the oolitic ages by the great reptiles of the extinct Dinosaurian order.

Strata and Localities of Megalosaurian Remains.

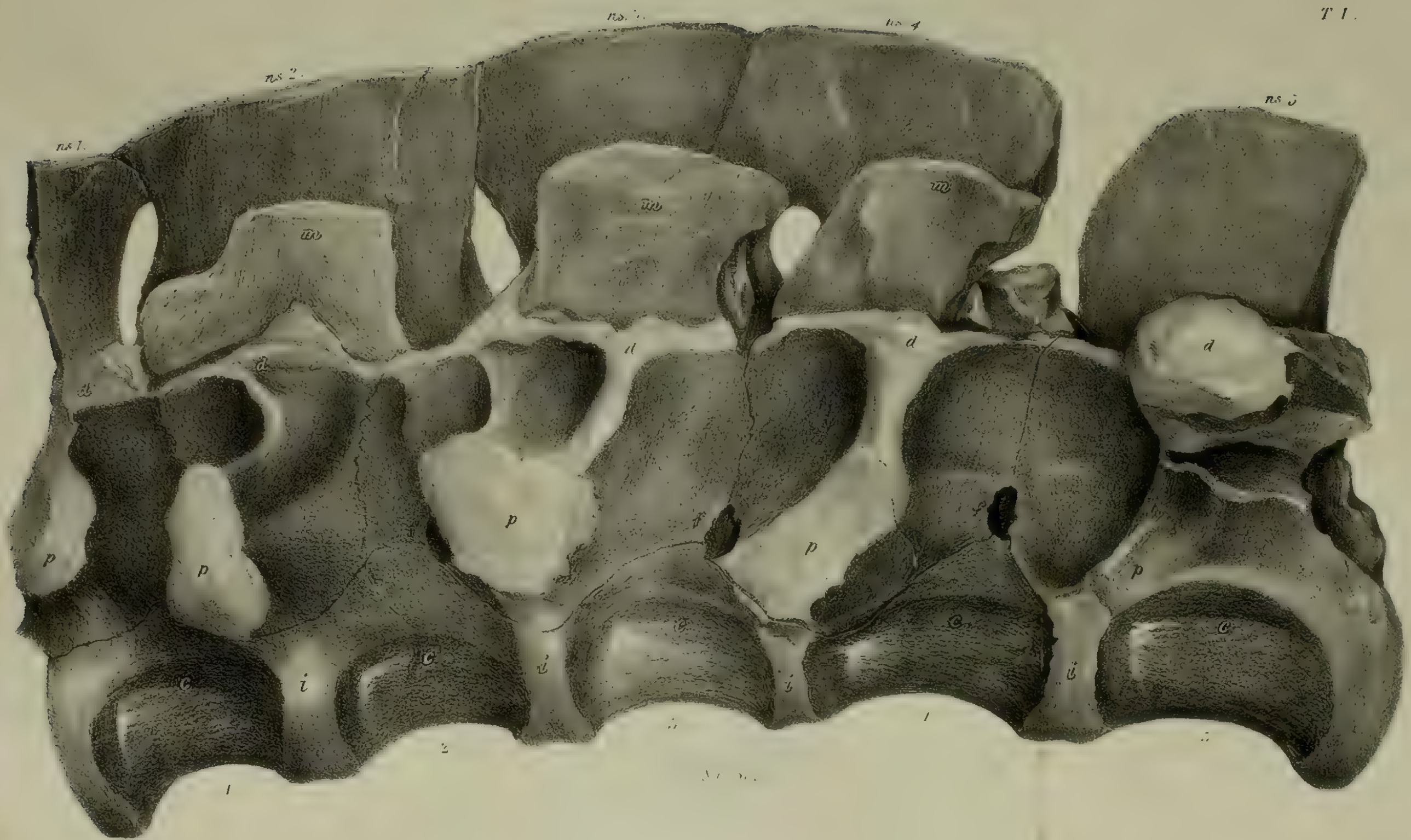
Besides the Stonesfield slate, the remains of the Megalosaurus have been found in

the Cornbrash and Bath Oolite immediately above that slate, and in Oolites beneath it. A tooth of a *Megalosaurus* has been kindly communicated to me by Mr. Woodward, of the British Museum, which was found in the Inferior Oolite of Selsly Hill, Gloucestershire, which is separated from the Stonesfield Oolite by superimposed deposits of Fullers' earth one hundred feet in vertical extent. Vertebræ and parts of long bones of the *Megalosaurus* have been found in the Inferior Oolite at Kingham, near Chipping-Norton, and at Broadwell, near Merke-in-the-Marsh, Gloucestershire. But the formation in which the remains of the *Megalosaur* occur, in quantity only inferior to those in the Stonesfield slate, is the Wealden strata. Dr. Mantell discovered in the ferruginous clay of the Forest of Tilgate a fine vertebra, and a portion of the femur of the *Megalosaurus*, 22 inches in circumference. Some fragments of the metacarpus and metatarsus from this locality, were thicker than those of a large hippopotamus. Many teeth, of the same form as those found by Dr. Buckland, at Stonesfield, have been obtained from Wealden strata. Mr. Holmes, surgeon, at Horsham, possesses a good caudal vertebra, and some other parts of the *Megalosaurus* from the furruginous sand near Cuckfield, in Sussex. The magnificent specimen of dorsal vertebræ, T. xix, *loc. cit.*, was discovered by Mr. Beckles, F.G.S., in the Wealden formation near Battle. Remains of the *Megalosaurus* occur in the Purbeck Limestone at Swanage Bay. In some of the private collections in the town in Malton, Yorkshire, are teeth, unquestionably belonging to the same species as the Stonesfield *Megalosaurus*, from the Oolite in the neighbourhood of that town.

TAB. 1.

Sacrum of the *Megalosaurus* ; half nat. size.

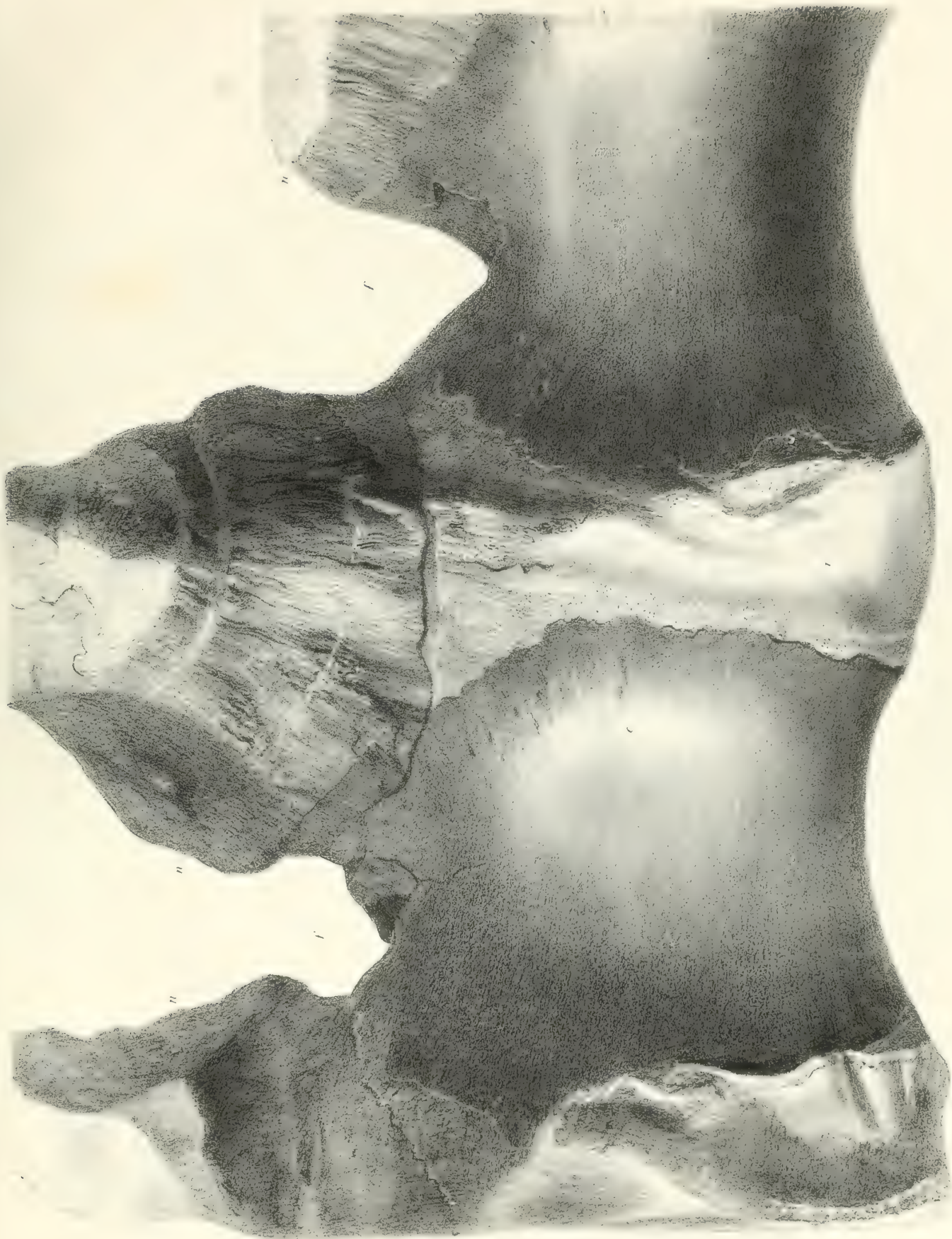
From the Oolitic Slate of Stonesfield, Oxfordshire. In the
Geological Museum, Oxford.



TAB. II.

Portion of the sacrum of the Megalosaurus ; nat. size.

From the Wealden, of Tilgate, Sussex. In the British Museum.

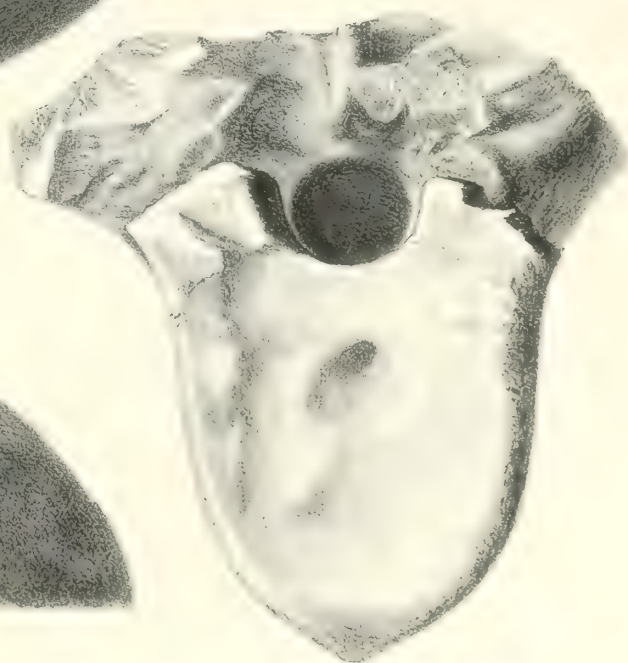
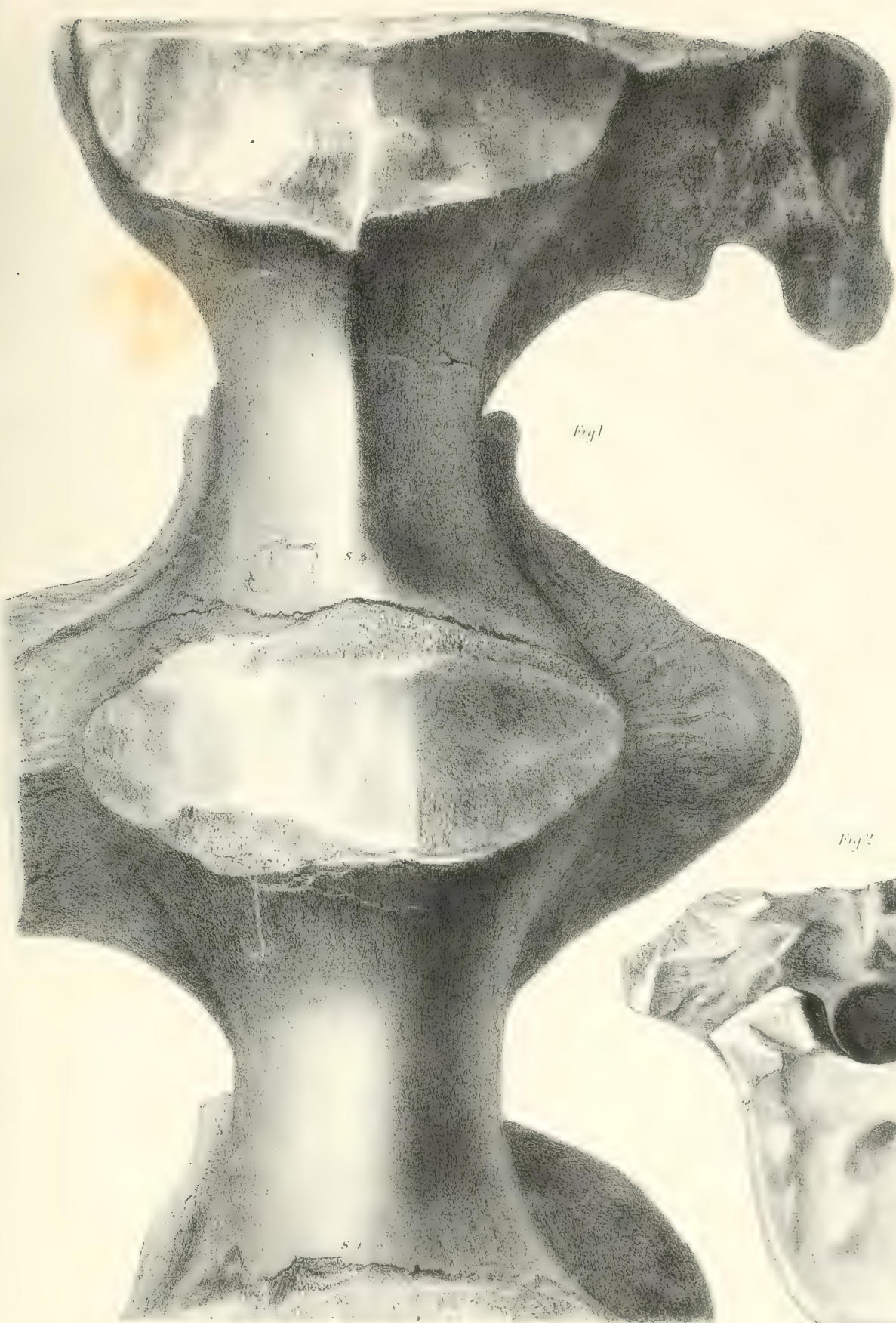


TAB. III.

Fig. 1. Under surface of the portion of the sacrum of the *Megalosaurus* ;
nat. size.

„ 2. End-view of the body of a sacral vertebra of the *Megalosaurus* ;
nat. size.

From the Wealden, of Tilgate, Sussex. In the British Museum.



TAB. IV.

Megalosaurus Bucklandi ; one fourth nat. size.

Fig. 1. Cervical, or anterior dorsal, rib.

„ 2. A succeeding dorsal rib : *c*, upper view of the head and neck.

„ 3. A posterior dorsal rib of a larger individual.

„ 4. The right clavicle.

„ 5. The right ischium.

Fig. 4



Fig. 2.

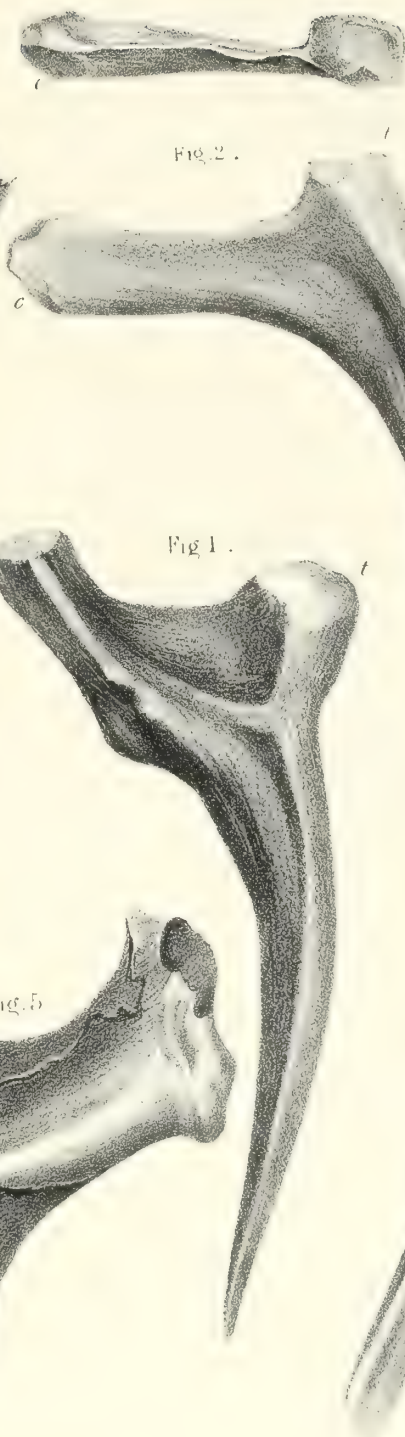


Fig. 1.



Fig. 5

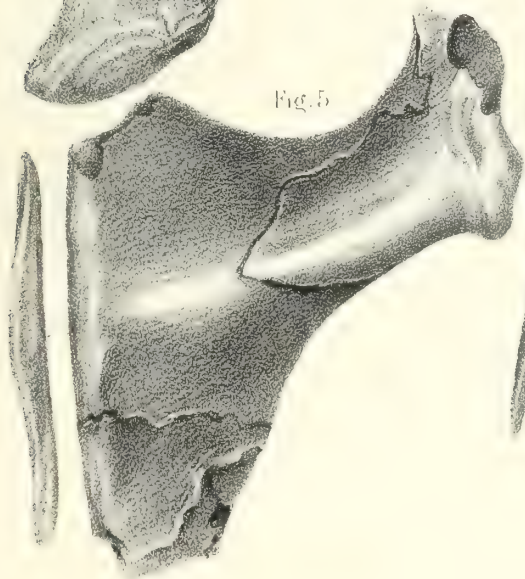


Fig. 3

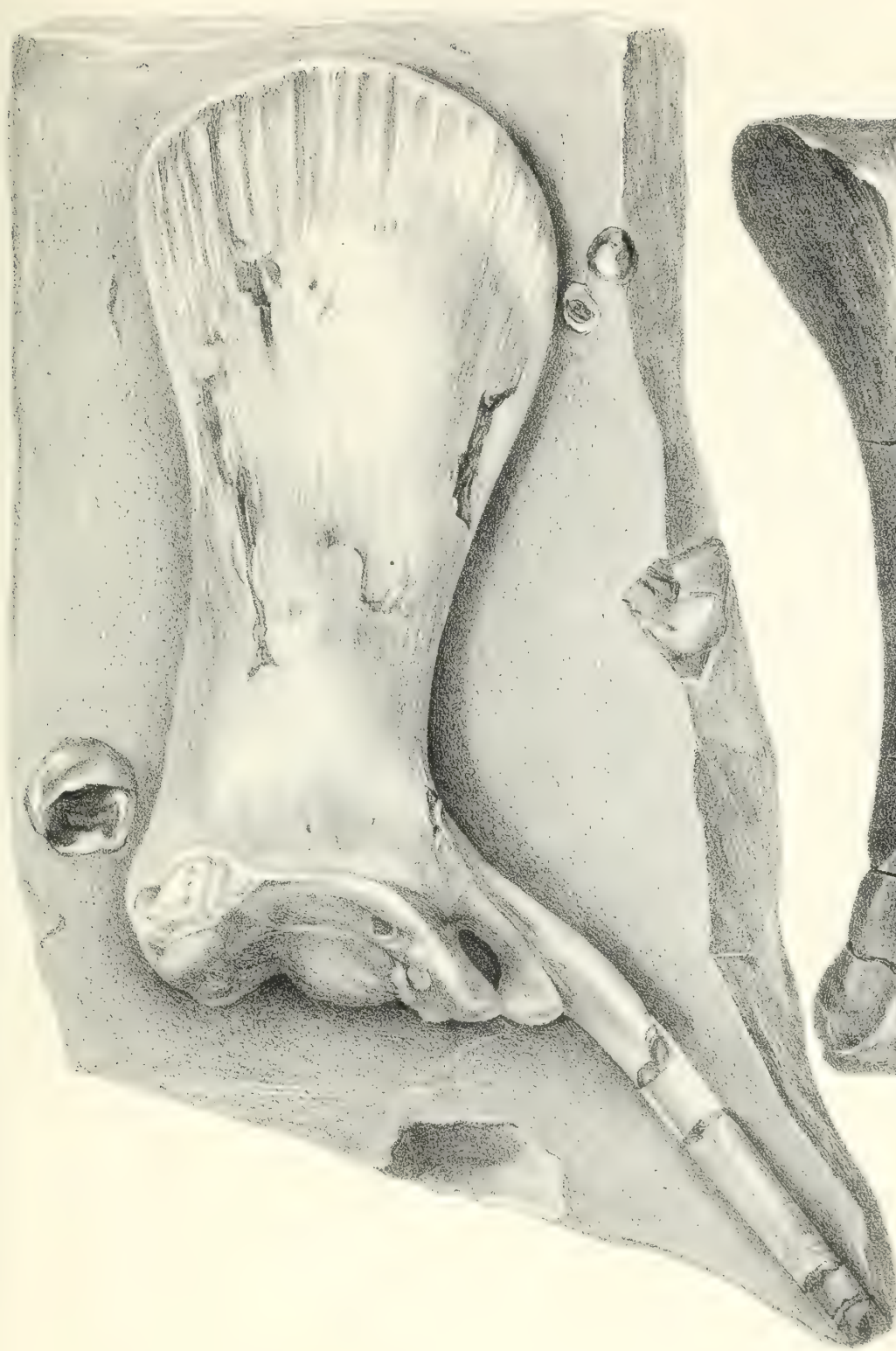


TAB. V.

The scapula of the *Megalosaurus* (?) ; one fourth nat. size.

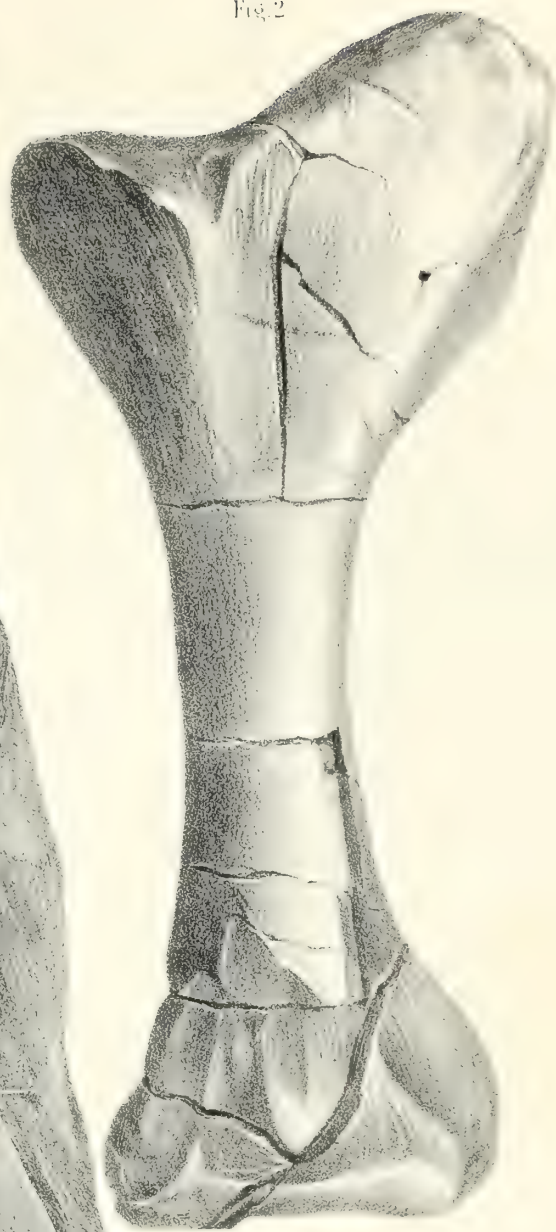
From the Wealden, of Sussex. In the Museum of J. B. Holmes, Esq.,
of Horsham.

Fig 1



T. F.

Fig 2



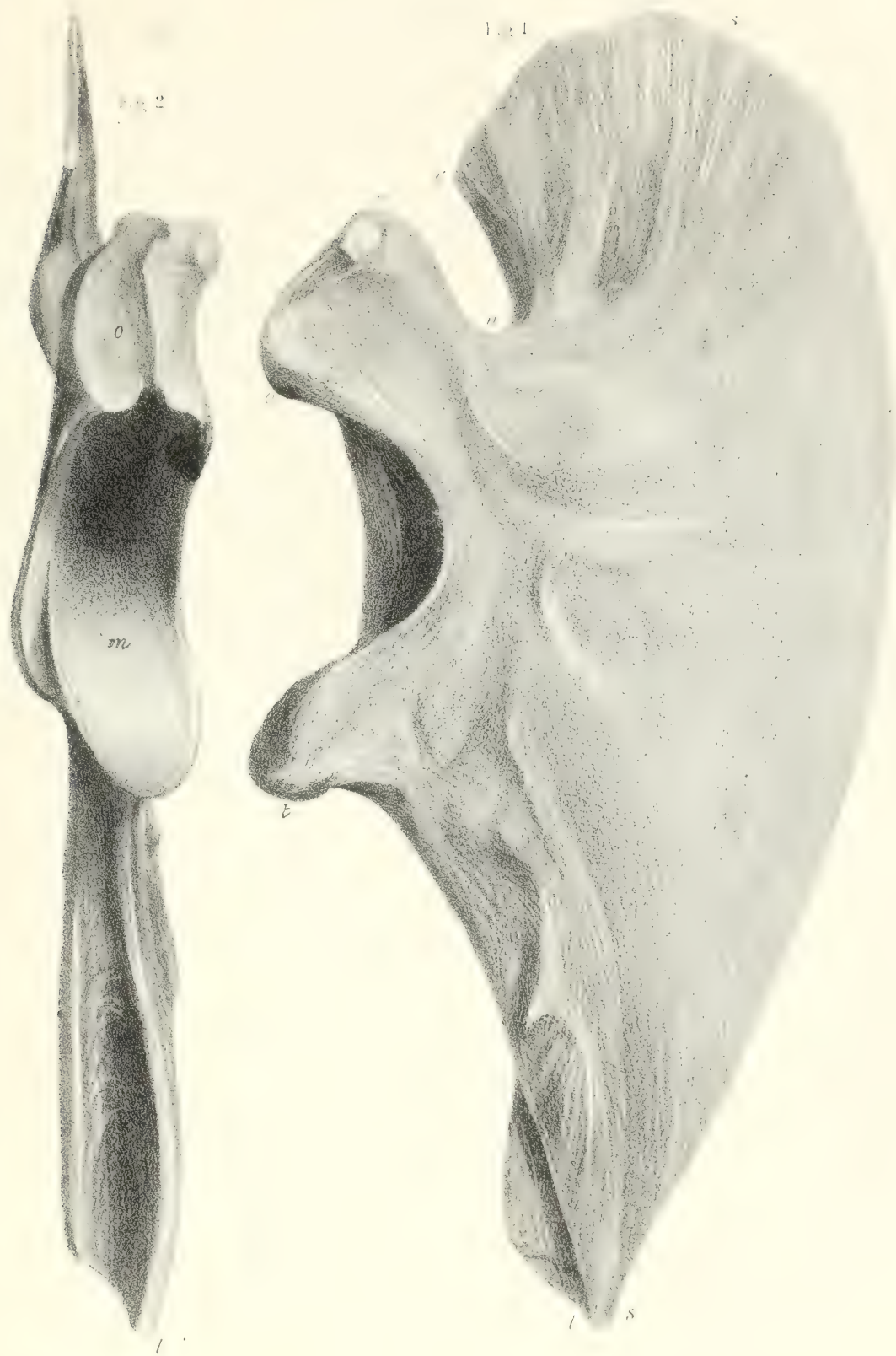
TAB. VI.

The coracoid of the Megalosaurus ; one fourth nat. size.

Fig. 1. Inner surface.

„ 2. Articular border.

From the Oolitic Slate, of Stonesfield, Oxfordshire. In the
British Museum.



1000

TAB. VII.

The femur of the Megalosaurus ; one fourth nat size.

Fig. 1. Hinder surface.

„ 2. Inner surface.

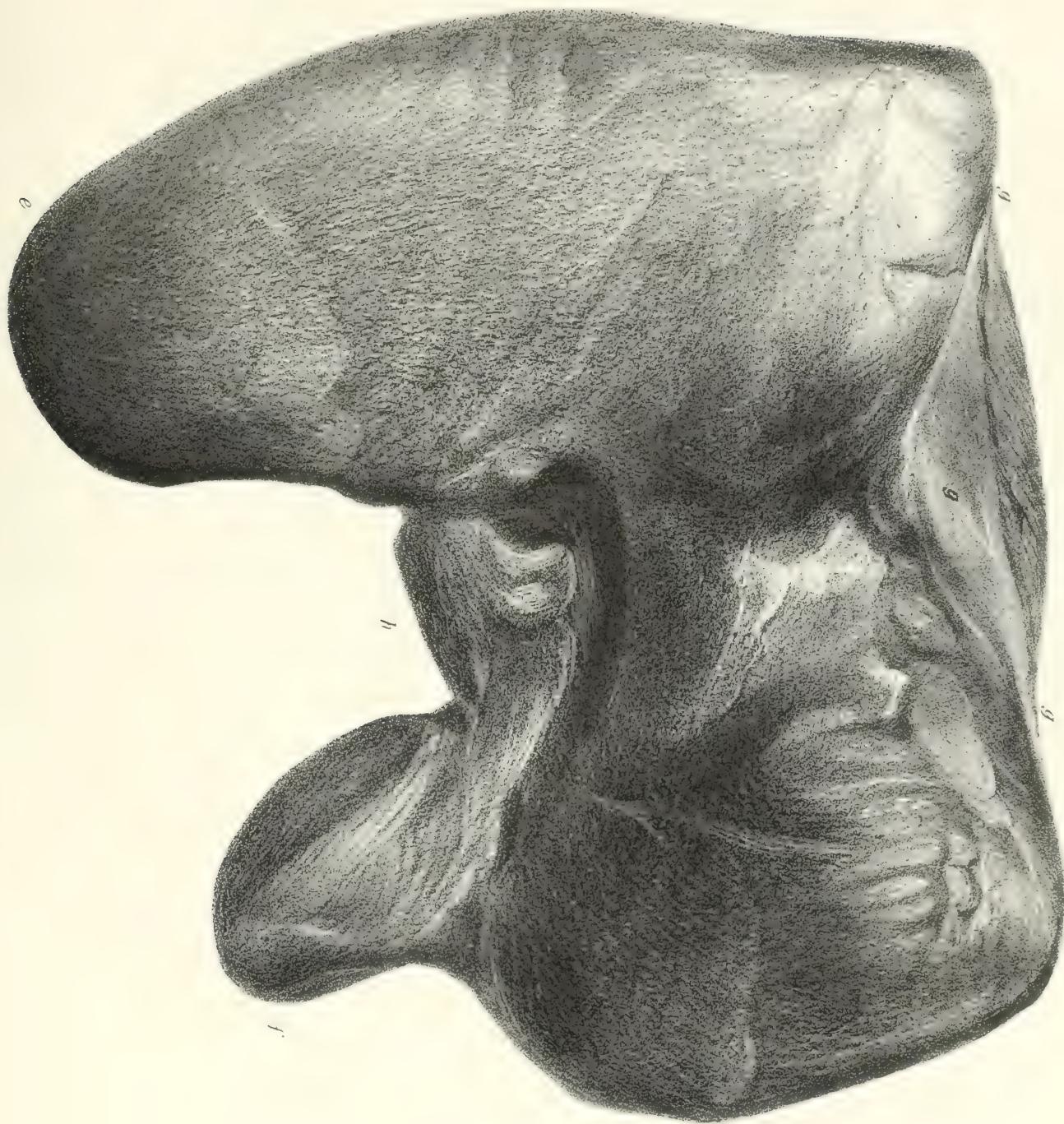
From the Oolitic Slate, of Stonesfield, Oxfordshire. In the
British Museum.



TAB. VIII.

Femoral condyles of the *Megalosaurus*; nat. size.

From the Oolitic Slate, of Stonesfield, Oxfordshire. In the
British Museum.



TAB. IX.

The tibia of the *Megalosaurus* ; one fourth nat. size.

Fig. 1. Outer surface, with the upper articular end.

„ 2. Hinder surface, with the lower articular end.

From the Oolitic Slate, of Stonesfield, Oxfordshire. In the
British Museum.

FIG. 1



FIG. 2



FIG. 3



TAB. X.

Ungual phalanges of *Megalosaurus* (?); nat. size.

- Fig. 1. Inside view.
,, 2. Outside view.
,, 3. Upper surface.
,, 4. The fractured end of figs. 1 and 2.
,, 5. Side view of a smaller entire phalanx.

From the Wealden Sand, Tilgate, Sussex. In the British Museum.

Fig. 3.



Fig. 1.

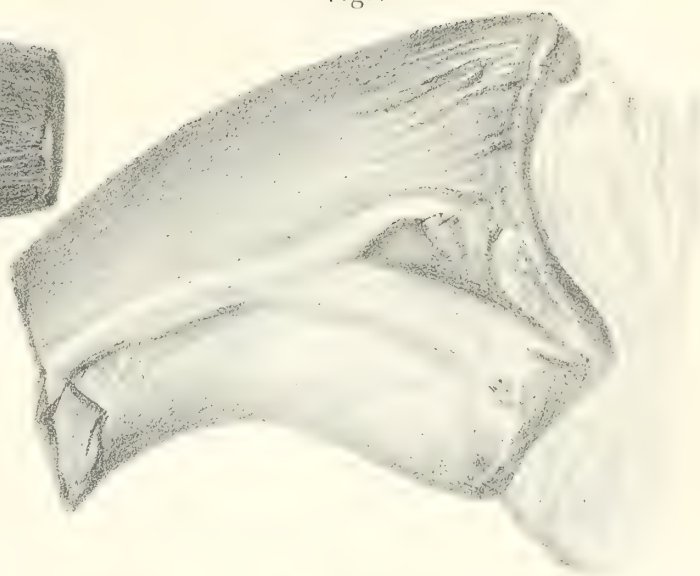


Fig. 4.

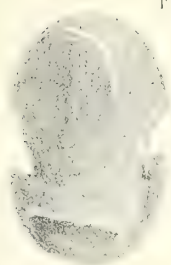


Fig. 5.

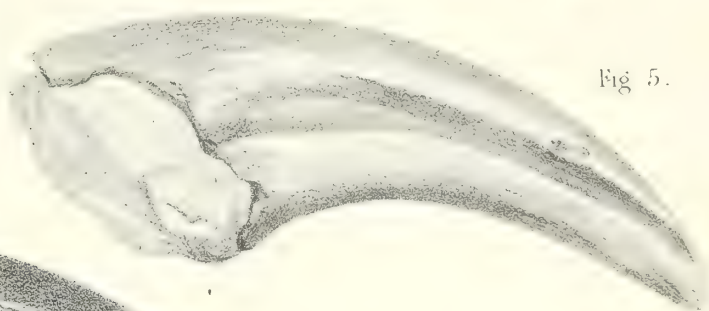


Fig. 2.



TAB. XI.

Megalosaurus Bucklandi, nat. size.

Fig. 1. Inside view of a portion of the dentary element of the mandible, with teeth.

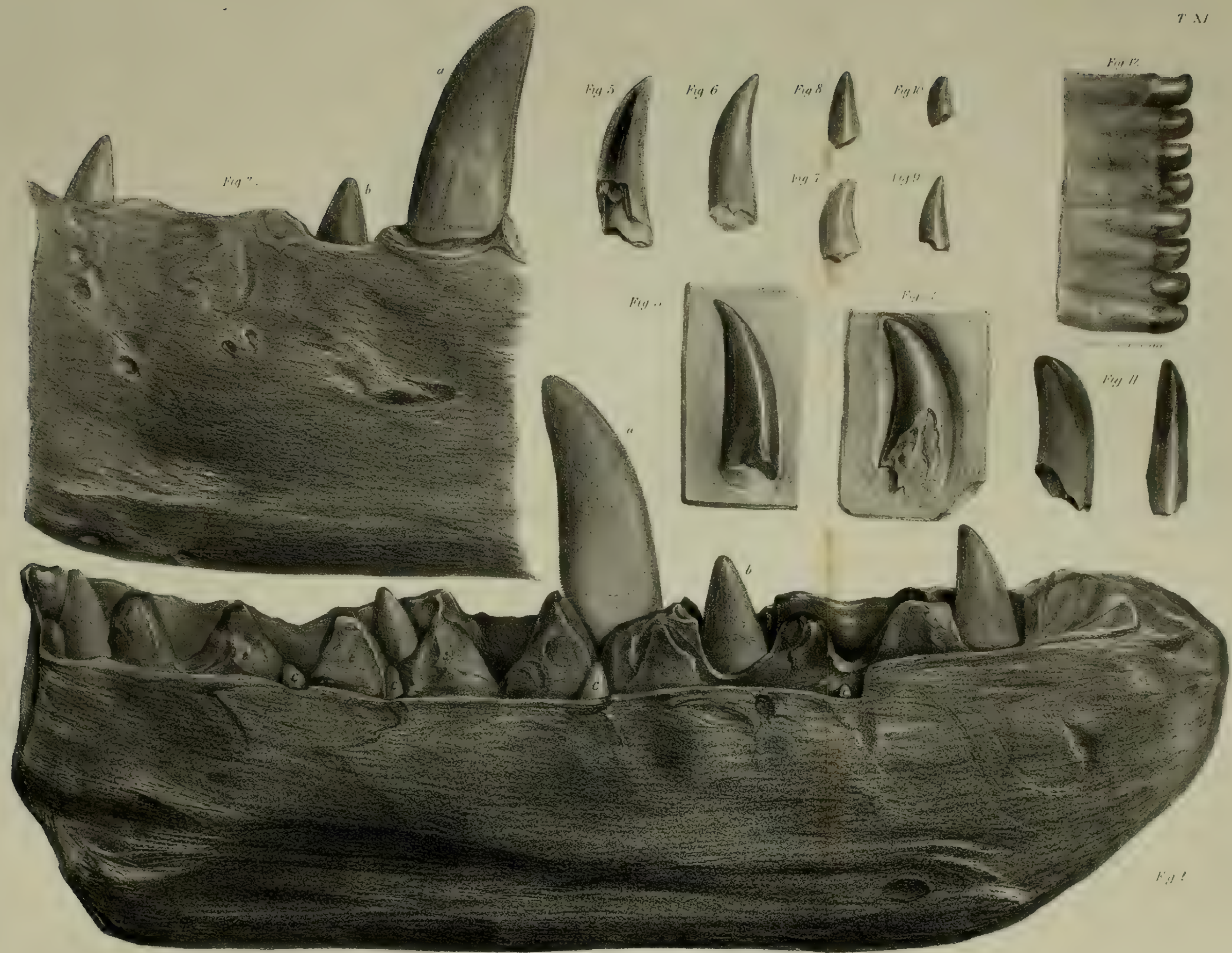
„ 2. Outside view of part of ditto.

„ 3—11. Various teeth, the last much worn.

„ 12. Magnified view of the finely serrated border of the teeth.

Figs. 4, 7, and 9 from the Wealden, of Sussex; fig. 5 from the Cornbrash, of Oxfordshire; fig. 7 from the Bath Oolite, Somersetshire; the rest from the Oolitic Slate, of Stonesfield, Oxfordshire.

All the specimens, save fig. 1, in the Oxford Museum, are in the British Museum.



TAB. XII.

Figs. 1—3. A portion of the mandible with teeth of the *Megalosaurus Bucklandi*; nat. size.

Fig. 4. Side-view of a full-sized tooth of the *Megalosaurus*.

„ 5. A portion of a tooth of *Megalosaurus*, from the Inferior Oolite, of Selsly Hill, Gloucestershire. In the British Museum.

The foregoing figures are taken, with the permission of his Grace the Duke of Marlborough, from a specimen in his Grace's collection, from the Oolitic Slate, of Stonesfield, Oxfordshire.

Fig. 1.

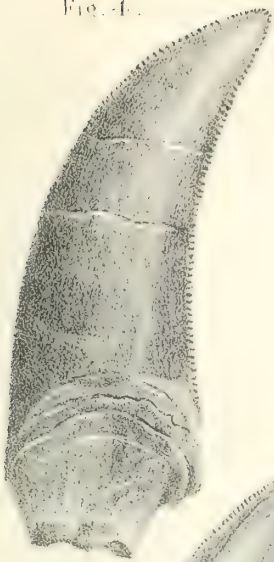


Fig. 2.



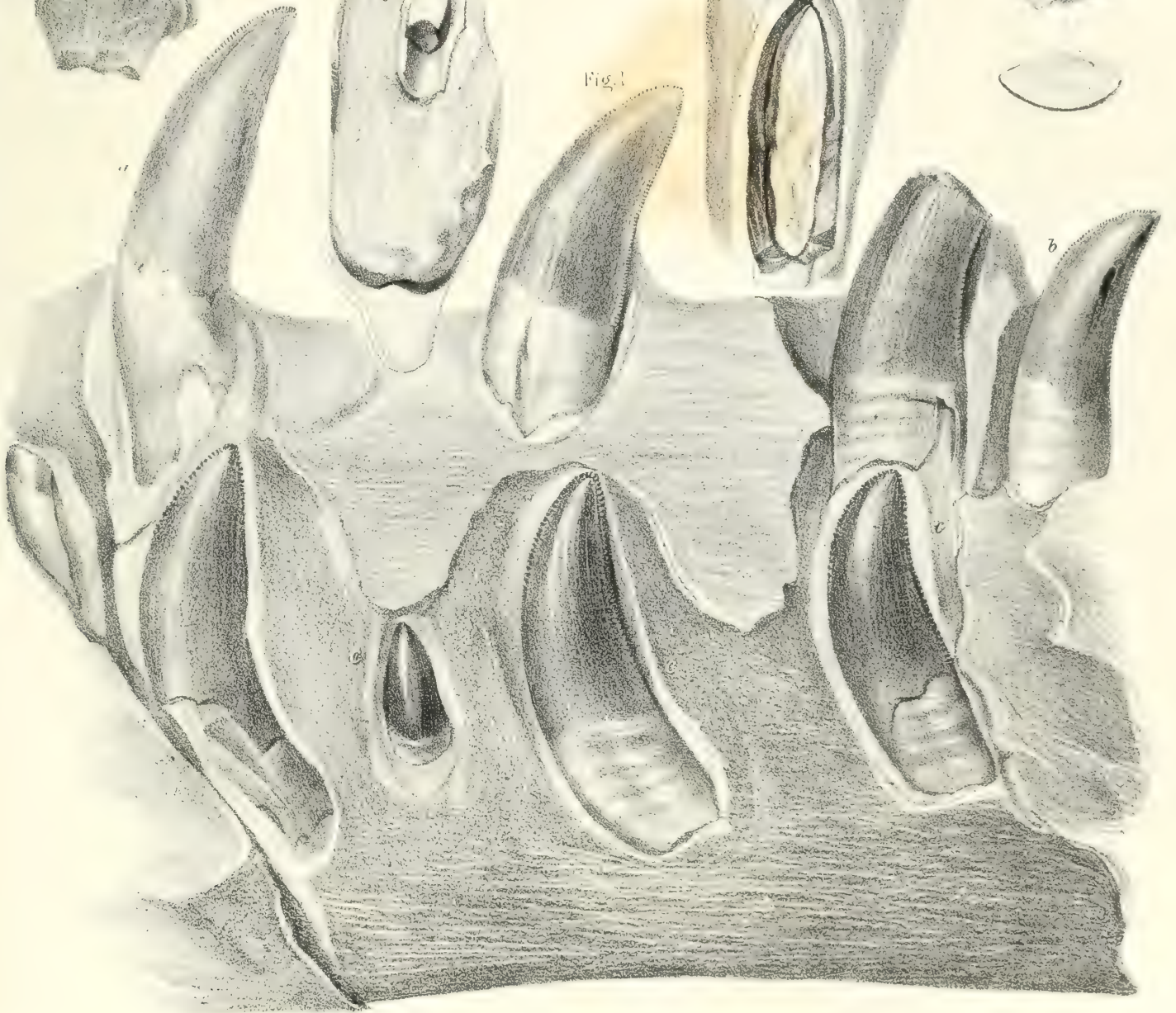
Fig. 3.



Fig. 5.



Fig. 4.



THE

PALÆONTOGRAPHICAL SOCIETY.

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MDCCCLVI.

A MONOGRAPH

OF

THE EOCENE MOLLUSCA,

OR

DESCRIPTIONS OF SHELLS FROM THE OLDER TERTIARIES
OF ENGLAND.

BY

FREDERIC E. EDWARDS.

PART III, No. II.

PROSOBRANCHIATA

(CONTINUED).

LONDON :

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1856.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

CORRIGENDUM.

Page 212, line 3 from the bottom, *add* "Nuneham" to the list of localities.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

In a fossil state, the genus first appears in the cretaceous formations, in which five or six species are stated to occur; but during the tertiary epoch, the species became much more numerous. More than forty have been described from the eocene strata, and a still greater number from the more recent deposits. From the English eocene strata, four species have been noticed; of these, three, described by Mr. Sowerby in 'Mineral Conchology,' appear to be confined to this country; the fourth occurs at Bracklesham, and is identical with a species abundant in the Paris basin. Three additional species are now described for the first time.

No. 118. MITRA SCABRA. *Sowerby*. Tab. XXIV, fig. 6 *a—c*.

SMALL LATTICED LYMINGTON WHELK, *Pet.* 1764. *Gazophyll.*, t. 73, fig. 9.

BUCCINUM SCABRICULUM, *Soland.* (non *Gmel.*) 1766. *Brand. Foss. Hant.*, p. 15, fig. 20.

MITRA SCABRA, *Sow.* 1823. *Min. Con.*, vol. iv, p. 142, t. 401.

— — *Morris.* 1843. *Cat. Brit. Foss.*, p. 151.

— — *D'Orb.* 1850. *Prod. de Paléont.*, vol. ii, p. 355, No. 313.

— — *Morris.* 1854. *Cat. Brit. Foss.* (2d edit.), p. 258.

M. testá ovato-acutá, costulis longitudinalibus et lineis transversis sese decussantibus scabratá, ad basin profunde emarginatá: spirá conicá, apice obtusiusculo: anfractibus convexis, marginibus posticis tenuibus: aperturá elongato-ovali, postice angustatá; labro incrassato, sub-marginato, intus crenulato; columellá quadri-plicatá, plicis distantibus, fere transversis; labii areá pliciferá incrassatá.

Shell ovately oblong, slightly ventricose, deeply notched at the base, with a conical spire, terminating in a small, slightly obtuse apex, formed of two smooth, nearly round, embryonal volutions; whorls seven or eight, exclusive of the embryo, and covered with irregular longitudinal ridges, and conspicuous lines of growth, decussated by sharp, transverse, raised lines slightly thickened at the points of decussation, roughening the surface of the shell; the posterior margins are thin, and pressed against the preceding whorls. The aperture is of a lengthened oval shape, narrowed posteriorly: the outer lip sharp and thin in the young shell, but irregularly thickened at maturity, and presenting an obscure, slender, raised border along the outer edge, and a blunt triangular tooth-like callus on the inner edge, near the posterior extremity; the columella is furnished with four distant, nearly transverse folds, of which the anterior one is much the smallest; and some specimens also present one or two obscure transverse lines towards the posterior part of the columella. The inner lip is very narrow, and much thickened where the folds are placed. Owing to the great depth of the notch, the base of the shell is more bent backwards than is usually the case in the fossil *Mitra*, and presents the prominent crest or ridge which, as we have seen in the *Volutes*, always accompanies a deep notch.

In the general form of the shell, the condition of the apex and of the outer lip, the columellar plaits, and the deep anterior notch, this *Mitra* so much resembles *M. labratula*, that it might almost be regarded as merely a variety of that species in which the longitudinal ribs and transverse lines found in the young state have been continued on the mature shell. I have not, however, met with any smooth specimen of the present species, and mature individuals of *M. labratula* are, apparently, always smooth, with the exception of a few obscure transverse lines near the suture, or at the base. This want of intermediate forms, therefore, confirms the title of *M. scabra* to specific distinction.

Size.—Axis, 11-12ths of an inch; diameter, 5-12ths of an inch.

Locality.—The species appears to be confined to the Barton beds. I have not met with it elsewhere.

NO. 119. MITRA LABRATULA. *Lamarck*. Tab. XXIV, fig. 3 *a, b*.

- MITRA LABRATULA, *Lamk.* 1803. Ann. du Mus., vol. ii, p. 58, No. 5, t. 3, fig. 6.
 — LABRATULLA, *Id.* 1816. Tab. Encycl. et Méthod., t. 392, fig. 3 *a, b*.
 — LABRATULA, *Id.* 1822. Hist. Nat., vol. vii, p. 325, No. 5.
 — — *Defr.* 1824. Dict. des Sci. Nat., vol. xxxi, p. 491.
 — — *Desh.* 1830. Encyc. Méthod. (vers.), vol. ii, p. 465, No. 42.
 — — *Id.* 1824—37. Descr. des Coq. Foss. &c., vol. ii, p. 672, t. 88, figs. 9, 10, 18 and 19.
 — — *Mellew.* 1843. Mém. sur les Sables tert. inf., &c., de Paris, p. 17.
 — — *Roissy.* . Buff. Moll., vol. v, p. 443.
 — MONODONTA, *Sow.* (non *Lamk.*) 1850. Dix. Geol., &c., Suss., p. 106, t. 7, figs. 20, 21.
 — LABRATULA, *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 354, No. 296.

M. testá ovato-acute, lævi, aliquando in juvenitá costulis et striis transversis decussatá, ad basin profunde emarginatá: spirá conicá, apice obtuso: aperturá elongatá, angustá; labro incrassato, sub-marginato, intús unidentato; columellá quadriplicatá.

Shell ovately oblong, slightly ventricose, smooth; sometimes in French specimens the early volutions present obscure undulating ribs, decussated by irregular, transverse, fine, raised lines, which altogether disappear on the last volution, or are reduced to a few faint lines, nearly obsolete, at the base, or round the sutural margin: the spire is conical with an apex formed, like that of *M. scabra*, of two roundish embryonal whorls, and, as in that species, the base is deeply notched, and bent backwards. The aperture is of a long, ovate shape, and rather narrow; the outer lip thickened, slightly bent outwards, so as to form a narrow, raised border along the outer margin, and furnished, generally, with a blunt, tooth-like callus on the inner edge, near the posterior extremity; the columella presents four prominent, almost transverse folds, the posterior three of which are nearly equal, and are larger than the one in front.

All the English specimens I have seen belong to the smooth variety, and do not present the longitudinal ribs and transverse lines which are sometimes found on the earlier whorls of the French shells, nor have I met with any specimen presenting the concentric striæ on the surface which characterise the variety from Courtagnon and the neighbourhood of Valognes.

I have already mentioned the strong resemblance between this species and *M. scabra*; in fact, with the exception of the scabrous aspect of the latter, it would be difficult to point out specific differences between the two.

M. Deshayes states that in some of the French specimens traces of the natural colouring remain, consisting of longitudinal iron-reddish coloured bands. The English specimens, imbedded in a less favorable matrix, do not present any traces of their original colouring.

Size.—Axis, 11-12ths of an inch; diameter, rather more than 5-12ths of an inch.

Localities.—Bracklesham Bay, where it is somewhat rare. *French*: Grignon, Parnes, Mouchy, Courtagnon, Chaumont, Valognes, St. Felix, Le Tomberay (fide *Desk.*), and Laon (fide *Mellel.*).

No. 120. MITRA PARVA. *Sowerby*. Tab. XXIV, fig. 1 *a—c*, and 2 *a—c*.

- MITRA PARVA, *Sow.* 1825. Min. Con., vol. v, p. 37, t. 430, fig. 1.
- PUMILA, *Ib.* 1825. Min. Con., vol. v, p. 37, t. 430, fig. 2.
- PARVA, *Ib.* 1850. Dixon's Geol., &c., of Sussex, p. 106.
- — *Morris.* 1843. Cat. of Brit. Foss., p. 151.
- PUMILA, *Ib.* 1843. Cat. of Brit. Foss., p. 151.
- PARVA, *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 355, No. 314.
- PUMILA, *Ib.* 1850. Prod. de Paléont., vol. ii, p. 355, No. 315.
- PARVA, *Morris.* 1854. Cat. of Brit. Foss., 2d edit., p. 258.
- PUMILA, *Ib.* 1854. Cat. of Brit. Foss., 2d edit., p. 258.

M. testá parvá, ovato-fusiformi, sub-turritá, concentrice sulcatá, ad basin vix emarginatá: spirá elevatá, acuminatá: anfractibus convexis, uno sulco prope marginem suturalem circumdatis; suturis distinctis: aperturá lanceolatá; labro undato, acuto, intús plicifero; columellá quinquies plicatá.

Var. SEMILÆVIS. Testá anfractibus uno sulco prope marginem suturalem circumdatis; et ad basin obscure sulcatis, cæterum lævi; spirá exsertiori.

Var. PUMILA, fig. 2 a—c. Testá fasciolis elevatis concentricis et costellis longitudinalibus decussatá.

Var. β. Testá costellarum longitudinalium experti.

Shell small, ovately fusiform, transversely furrowed, and but slightly notched at the base; spire elevated, pointed, and formed of seven or eight convex volutions,

separated by a deep suture, and with the margins thickened and rather depressed, giving a sub-turreted character to the spire; the furrows are broad, round, and nearly regular; the posterior furrow is deeper than the others, and from this circumstance the margin of the whorls assumes the appearance of a rim. The aperture is narrow, and of a lengthened oval form; the outer lip waved, sharp-edged, and plicated within, at a short distance from the margin; the columella is nearly straight, and presents near the middle two rather prominent and nearly transverse folds, and in front of them three others more oblique, and of which the anterior one is much the smallest.

In the variety *semilævis*, the whorls are nearly smooth, presenting only the deep sulcus round the sutural margin, and a few obscure furrows, almost obliterated, near the base; and the spire is rather more elevated than in the type.

In the variety *pumila*, the surface of the whorls presents numerous longitudinal, irregular, slightly waved costellæ, not much elevated, but extending almost to the base, and crossed by concentric raised bands, which decussate them, and impart a rough aspect to the shell. The concentric bands are irregular, more or less numerous in different individuals, and rather flattened on the upper surface. When the costellæ are well defined, the concentric bands, at the points of decussation, rise into little tubercles; the marginal band, thus tuberculated, forms the crenulated edge to the whorls noticed by Mr. Sowerby; but this does not appear to be a constant character.

Occasionally specimens occur (*var. β*) in which the longitudinal costellæ are altogether wanting, and the whorls present only the concentric bands.

If we look only at the extreme forms figured in 'Mineral Conchology,' it need not excite surprise that Mr. Sowerby, who had not any intermediate forms before him, should have described the variety *pumila* as a distinct species. On an attentive examination, however, it will be seen that the distinction between that variety and the type lies in the character of the transverse marking, which in the type consists of shallow, rounded furrows; while in the variety it assumes the form of flattened bands. This difference, however, which is attributable to the greater, or less depth of the furrows, cannot be regarded as of specific value; and the occurrence of ribless specimens with transverse bands, shows that the presence or absence of the costellæ is not a character on which reliance is to be placed.

The apex of the shell appears to have been very susceptible of erosion, for specimens with the embryonal whorls preserved are very rare.

Size.—Axis, rather more than 3-12ths of an inch; diameter, 2-12ths of an inch, nearly.

Localities.—For the type, Highcliff, where it is found in profusion, Barton, Alum Bay (No. 29, Prestw.), where the variety *semilævis* is abundant, and Brockenhurst; and for the variety *pumila*, Highgate, Basingstoke, Bracklesham Bay, Bramshaw (New Forest), and Barton. The species appears to be confined to England.

No. 121. MITRA PORRECTA. *F. E. Edwards.* Tab. XXIV, fig. 7 *a—c.*MITRA PORRECTA, *Morris.* 1854. Cat. Brit. Foss., 2d edit., p. 258.

M. testá elongato-fusiformi, gracili, ad basin concentricè sulcatá, cæterum lævi; spirá porrectá: anfractibus depresso-convexis, unico sulco prope marginem suturalem circumdati; marginibus posticis simplicibus: aperturá angustá, lineari; labro acuto, intús crenulato; columellá quinquies plicatá.

Shell elongated, fusiform, slender; smooth, except at the base, where it is traversed by several broadish, obscure furrows; the spire elevated, nearly equalling the aperture in length; the volutions, seven or eight, flatly convex, with the posterior margins simple, and bordered by a deep furrow, which runs round the shell near the suture. The aperture is narrow, with nearly parallel margins; the outer lip sharp-edged, and finely and regularly crenulated within; the columella presents five sharp folds, of which the anterior two are very oblique, and much smaller than the others.

In the smooth surface, margined whorls, sharp outer lip, and columellar folds, this Mitra resembles *M. marginata* (Lamk.), from the Paris basin. It is, however, a much narrower and more slender shell; the margins of the whorls are without the crenulations which characterise that species, and the outer lip is finely crenulated within. The species appears to be perfectly distinct.

Size.—Axis, 4-12ths of an inch; diameter, 1-8th of an inch.

Localities.—Barton, Bracklesham Bay.

No. 122. MITRA OBESA. *F. E. Edwards.* Tab. XXIV, fig. 4 *a—d.*

M. testá ovato-oblongá, ad basin concentricè sulcatá, cæterum lævi; spirá acuminatá, aperturam in longitudine vix æquanti; anfractibus convexiusculis, antice coarctatis, postice marginatis; aperturá elongato-ovali; columellá terties plicatá.

An ovately oblong shell, smooth except at the base, where it is traversed by a few obscure furrows; spire elevated, nearly as long as the aperture, and terminating in a small, pointed pullus, formed of two round, smooth, unequal volutions; the whorls, which are five in number, exclusive of the embryo, are flatly convex, and contract rather suddenly in front; the posterior margin is bordered by a shallow furrow, which runs round the suture, and the edge is depressed and flattened, giving somewhat of a turreted appearance to the spire. The aperture is ovate, moderately wide, and terminates in front in a short, wide canal, formed by the sudden contraction of the whorl; the columella is nearly straight, and presents three oblique distant folds.

The general form, the width and greater size of the shell, and the number of the

columellar plaits, distinguish this species from the smooth variety of *M. parva*, and from *M. gracilis*. It is extremely rare: the specimen figured is, I believe, unique.

Size.—Axis, 5-12ths of an inch; diameter, rather more than 2-12ths of an inch.

Locality.—Highcliff.

NO. 123. MITRA VOLUTIFORMIS. *F. E. Edwards*. Tab. XXIV, fig. 5 *a—c*.

MITRA VOLUTIFORMIS. *Morr*. 1854. Cat. Brit. Foss., 2d edit., p. 258.

M. testá parvá, oblongá, turrítá, longitudinaliter costatá, antice transversim lineatá, postice concentricè sulcatá, cæterum lævi; spirá exsertá, in longitudine dimidium totius testæ superanti: anfractibus planis, antice subito coarctatis, ad suturas marginatis et unicâ serie tuberculorum instructis; costis crebris, elevatis, rectis, fere ad basin tendentibus, postice nodulosis: aperturá angustá; labro intus plicato; columellá quadriplicatá; labio angustissimo, postice incrassato.

Shell small, oblong, turreted, longitudinally ribbed; spire elevated, exceeding the aperture in length; whorls five or six, exclusive of the embryonal whorls, with the sides nearly straight, and contracting suddenly towards the base, where they present five or six transverse, coarse, raised lines; the sutural margin is bordered by a single row of round tubercles, corresponding with the ribs; the posterior surface is concentrically furrowed; the middle surface smooth; the ribs, which are numerous, prominent, and straight, extend to the transverse raised lines on the base, and terminate, posteriorly, in a double row of knobs or tubercles, somewhat larger than those which run round the suture, and from which they are separated by a deep furrow. The aperture is lanceolate, and, owing to the contraction of the whorls, terminates anteriorly in a short, narrow canal, which is slightly emarginate in front; the outer lip is plicated within; the inner lip very narrow, and thickened near the suture, where it forms an oblong callus; the columella is slightly curved, and furnished with four oblique folds, gradually increasing in size as they ascend the columella.

The specimen figured is, I believe, unique. It is apparently an immature shell; but the characters are so strongly marked, and so distinct from those of the other English Eocene Mitræ, that it cannot be passed unnoticed.

Size.—Axis, 3-12ths of an inch; diameter, somewhat less than 2-12ths of an inch.

Locality.—Barton.

Family—CONIDÆ.Genus 25th. CONUS. *Linn.*CONUS *Brug.; Lamarek; Cuvier; De Blainv.*VOLUTA, *Browne* (not *Linn.*), 1756.STROMBUS, *Adan.* (not *Linn.*), 1757.CUCULLUS, *Bolten*, 1798.CONARIUS, *Dumér.*, 1806.RHOMBUS, *Montfort*, 1810.CONULUS, *Rafin.* (not *Fitzing.*), 1814.PUNCTICULIS—CORONAXIS—CONILITHES, *Swains.*, 1840.STEPHANOCONUS, *Mörch*, 1852.CYLINDRELLA, *Swains.* (not *Pfeiffer*), 1840.DENDROCONUS, *Ib.* 1840.LITHOCONUS, *Mörch*, 1852.CYLINDER, *Montfort*, 1810.TEXTILIA, *Swains.*, 1840.HERMES, *Montfort*, 1810.THELICONUS, *Swains.*, 1840.LEPTOCONUS, *Ib.* 1840.RHIZOCONUS—CHELYCONUS, *Mörch*, 1852.Sect. α NUBECULA, *Klein*, 1753.ROLLUS, *Montfort*, 1810.UTRICULUS, *Schum.*, 1817.TULIPARIA, *Swains.*, 1840.Sect. β CONORBIS, *Ib.* 1840.

Gen. Char.—Shell inversely conical, turbinate, rarely ventricose, smooth or concentrically furrowed or striated; spire truncate, short, or more or less elevated: whorls numerous, coronated or simple; aperture linear, narrow, slightly effuse, and emarginate in front; outer lip thin, and sharp at the edge, smooth, sometimes thickened within, generally straight, occasionally curved, notched at the suture; columella straight, smooth, truncate in front; covered with an epidermis, and operculated; operculum small, corneous.

In the genera which constitute the families *Cypræidæ* and *Volutidæ*, the animals are distinguished by their large mantles, capable, as we have seen, of great extension. In the present genus, the type of the family to which its name is given, the animal is furnished with a narrow mantle, prolonged in front into a short, fleshy siphon, resembling that of the *Volutes* and *Mitres*, by which water is conveyed to the branchial chamber. The head is small, and carries two subulate tentacles, near the free extremities of which the eyes are placed: it terminates in a retractile, proboscis-like muzzle.

at the end of which is the mouth, surrounded by a funnel-shaped veil: the teeth are elongate, subulate, and arranged in two series. The foot is simple, oblong, narrow, and truncated in front; in the middle it presents a pore, the function of which is not ascertained; and it bears, on the posterior extremity, a small, ovate, horny operculum, barely exceeding in length a third part of the aperture, and very narrow, so as to permit the animal to withdraw far within the shell. The epidermis, which covers the shell, is thick, and frequently very tenacious.

The cone-animal is endowed with the power of dissolving the calcareous matter on the outer surface of the inner whorls, which are thus made exceedingly thin, whatever degree of thickness they may have originally possessed. This power of absorption is possessed by many other molluscs, but, according to Mr. George Sowerby, is confined to those furnished with an operculum. It affords a valuable assistance to the Palæontologist.

The present genus, although comprising very many species, remains almost as Linnæus left it. The foregoing list of synonyms shows, indeed, that many dismemberments have been proposed; but at present these appear to depend principally on differences in the shells. In Klein's proposed genus *Nubecula*, however, the shell of which is sub-cylindrical, the animal, according to M. Quoy,* is furnished with a large foot, not entirely retractile within the shell; the margin of the muzzle is fringed, and the operculum is curved and unguiculate: these peculiarities apparently justify the division in question being retained as a sub-genus.

The wide semicircular notch which, in many of the cones, separates the outer lip from the suture, closely resembles the sinus characteristic of the *Pleurotomæ*, and in some of the fossil species in which the outer lip is generally very much curved, it is difficult to determine to which genus the particular shell should be referred. In the well-known Eocene species, *Conus dormitor* (Sol.), for instance, the shell outwardly possesses quite as much of the character of a *Pleurotoma* as of that of a *Cone*; and Mr. Swainson has, in fact, taken it as the type for a genus which he has named *Conorbis*, and which, in his circle of affinities of the *Coninæ*, he regards as the representative of the *Pleurotomæ*. This division depends entirely on the external characters of the shell: no living representative, I believe, has as yet been found, and the animal is therefore unknown. It is certain, however, that it was a true cone-animal; for, on breaking the shell of a specimen of *Conus dormitor*, the inner whorls will be found reduced by absorption to a membrane-like thinness; and the capability to effect this is not, I believe, possessed by the animal of *Pleurotoma*. The proposed genus is not well defined by its author, and is not generally received, although it may be usefully adopted as a section of the present genus. The characters appear to be the elevated conical spire, the produced base representing the canal which dis-

* Zoologie of the Voyage of the *Astrolabe*.

tinguishes the *Pleurotomæ*; the condition of the outer lip, which is much thickened within, and so strongly arched as to be almost semicircular in form; the deep, wide sinus, which divides the posterior extremity of the outer lip from the suture, and exactly resembles the notch by which the *Pseudotomæ* (a section of the *Pleurotomæ* proposed by Bellardi) are distinguished; and the elevated, reflected anterior margin of the columellar lip, forming the right wall of the anterior canal.

The recent cones, distinguished by the beauty and variety of their colouring, are very numerous: three hundred and sixty-nine species are enumerated by Messrs. Henry and Arthur Adams in the different divisions adopted by those authors; and, excepting two species which are found in the Mediterranean, all are inhabitants of tropical seas, abounding chiefly in those of Asia. They inhabit fissures and holes in rocks, and coral reefs, ranging in depth from low-water mark to thirty or forty fathoms.

In a fossil state, the genus first occurs in the upper cretaceous strata. M. Deslongchamps, it is true, has referred to it certain shells from the lias of Calvados, exactly resembling cones in outward form, and which, if the genus were correctly determined, would present the anomaly of the cones not being represented during the long epoch which elapsed between the deposit of the middle lias and that of the upper chalk. M. D'Orbigny, however, found, on examination, that the inner whorls were as thick as the outer ones; and from this circumstance he has inferred that the shells in question are not true cones, and he has referred them to *Acteonina*, a genus peculiar to the Oolitic formations, and proposed by him for certain Acteon-like shells, without teeth or folds on the columella. And thus the apparent anomaly disappears. In Europe two species only have hitherto been found in the Chalk—one from Tours, described by Dujardin; the other from Martigues (Bas du Rhone), described by Mathéron: and from the eocene strata, sixteen species have been described by Solander, Bruguière, Lamarck, Sowerby, and Deshayes. After the eocene era, the genus disappears from our Fauna; although, on the Continent, it appears to have been largely developed during the miocene and pleiocene epochs, sixty-seven species having been described by Grateloup, Michelotti, Brocchi, Borson, and other authors, from the formations of those periods, in France, Italy, and Germany. In America only four species, I believe, have as yet been found—one in the Chalk of South Carolina, a second in the eocene strata of Alabama, and two in the more recent formations.

No. 124. CONUS DIADEMA, *F. E. Edwards*. Tab. XXIV, fig. 8 *a—d*.

CONUS DIVERSIFORMIS, *Sow.* (non *Desh.*) 1841. Min. Con., vol. vii, p. 26, t. 623, figs. 3, 4, 6.

— — *Morris.* 1843. Cat. Brit. Foss., p. 143.

— — *Sow.* 1850. Dixon's Geol., &c., of Suss., p. 108, t. 8, fig. 10.

— — *Morris.* 1854. Cat. Brit. Foss., 2d edit., p. 244.

C. testá conicá, oblongá, sub-turritá, coronatá, lævi, ad basin transversim obscure sulcatá; spirá elevatá, sed trientem totius testæ longitudine nequaquam æquanti; anfractibus numerosis, angulatis, marginibus posticis depressis, sub-cavatis, concentricè lineatis: aperturá angustá; labro mediocriter arcuato, postice late emarginato.

Var. PYRIFORMIS (fig. 8 *d*). *Testá spirá depressá.*

CONUS PYRIFORMIS, *Sow.* 1850. Dixon's Geol., &c., of Suss., pp. 108 and 189, t. 8, fig. 18.

— — *Morris.* 1854. Cat. Brit. Foss., 2d edit., p. 244.

A smooth, oblong, conical shell, with a turreted spire, formed of numerous (10—12) volutions, and moderately elevated, varying to some extent in different individuals, but never attaining a height equal to a third part of the length of the shell. The whorls are nearly straight on the sides, with the posterior margins much depressed, somewhat concave, and ornamented with four or five thickish, concentric, raised lines, separated by shallow, rounded furrows; the angles of the whorls present a series of oblong, regular tubercles, which are continued almost to the last whorl, when they are replaced by a rounded, cord-like thickening of the shoulder; the front part of the whorls is traversed by shallow, irregular furrows, which are effaced towards the middle part of the shell. The aperture is narrow, with parallel margins; the outer lip moderately arched, and presenting a wide, shallow curvature between the angle and the suture.

The specimens separated by Mr. Sowerby, under the specific name *pyriformis*, have a much depressed spire associated with the tuberculation, and other characters which distinguish the present species, of which, therefore, I regard them as a variety only.

The shells for which I propose the specific name, *C. diadema*, were referred by Mr. Sowerby, in part to *C. deperditus* (Brug.), and in part to *C. diversiformis* (Desh.). In the former species, however, the shell is narrower and more turbate, with a more curved outer lip, and the tuberculation on the spire, where it occurs, is feeble and lost on the very early whorls; and in the latter species, M. Deshayes, in his description, states expressly that the angles of the whorls are somewhat sharp, and always simple;*

* It is somewhat difficult to appreciate the distinct specific value of the shells constituting the species *C. diversiformis*, without an examination of a series of specimens equal to that upon the study of which M. Deshayes proposed the separation. To the unschooled eye they appear to be only broader forms of *C. deperditus*, with more variable spires.

while in the English shells, the angles of the whorls are blunt and strongly tuberculated, resembling in that character *C. sulciferus* (Desh.), to which, indeed, I should be inclined to refer them, notwithstanding the transverse sulcation from which the name is taken, but on which much stress is not to be placed, as it does not appear to be a strongly marked character; the shell of *C. sulciferus*, however, is thick and ponderous, with a narrower aperture, and a deeper curvature in the outer lip. In *C. Lamarckii* (a name which I propose to give to the cocene species still miscalled *C. antediluvianus*), the tubercles are also found, but they are not so prominent nor so persistent as in the present species; the shell, also, is narrower, with a sub-conical and more elevated spire, and it never attains the size of *C. diadema*. The only other cocene tuberculated species at all resembling the present one, is *C. crenulatus* (Desh.); but in that species the shell is perspicuously furrowed, even in its mature state, and the spire is shorter and more conical.

Size.—Axis, 2 inches and 10-12ths (72 millim.); diameter, 1 inch and 8-12ths (42 millim.).

Locality.—Bracklesham Bay, where it is common.

No. 125. CONUS DEPERDITUS. *Bruguière*. Tab. XXV, fig. 2 *a—c*.

- D'Argenv.* 1742. Conchyl. Append., 2d edit., p. 349, t. 29, fig. 8.
 ? *Walch.* 1768. Traité des Petrifact., vol. ii, p. 102, t. 43, fig. 4.
Favanne. 1780. D'Argenv., Conchyl., 3d edit., t. 66, fig. 61.
 CONUS DEPERDITUS, *Brug.* 1789. Encycl. méth., vol. i, p. 691, No. 80, t. 337, fig. 7.
 — — *Lamk.* 1802. Ann. du Mus., vol. i, p. 386; vol. xv, p. 441, No. 6.
 — — *Def.* 1818. Dict. des Sci. nat., vol. x, p. 261.
 — — *Lamk.* 1822. Hist. Nat., vol. vii, p. 528, No. 6.
 — — *Desh.* 1823. Dict. class. d'Hist. nat., vol. iv, p. 388.
 — — *Ib.* 1824—37. Descr. des coq. foss., &c., vol. ii, p. 745, t. 98, figs. 1, 2.
 — — *Galeotti.* 1837. Const. géog., &c., de Brabant, p. 148, No. 63.
 — — *Bronn.* 1838. Lethæa geog., vol. ii, p. 1118, t. 42, fig. 14. (ex plur. syn.)
 — — *Sow.* 1841. Min. Con., vol. vii, p. 25, t. 623, fig 5 (non figs. 1, 2).
 — — ? *Nyst.* 1843. Coq., &c., de Belg., p. 583, No. 501.
 — — *Morris.* 1843. Cat. Brit. Foss., p. 143.
 — — *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 355, No. 336.
 — — ? *Bell.* 1851. (Foss. nummul. du Comté de Nice), Mém. de la Soc. Géol. de France, 2d ser., vol. iv, p. 219, No. 65.
 — ALLIONI? *Beyr.* (non *Michel.*) 1853. Die Conchyl. des Norddeut. tertiär., p. 24, t. 1, figs. 4—6.
 — DEPERDITUS, *Roissy.* 1804. Buff. Moll., vol. xlv, p. 409, No. 10.
 CONILITHES CINGULATUS, *Schlot.*? 1820. Die Petrif., vol. i, p. 125, No. 3.

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| Nec CONUS DEFERDITUS, | <i>Brocc.</i> | 1814. | Conch. Foss. Sub-app., vol. ii, p. 592, No. 10, t. 3, fig. 2. |
| nec — — — | <i>Bors.</i> | 1821. | Oritt. Piem., p. 14, No. 13. |
| nec — — — | <i>Brongn.</i> | 1823. | Terr. tert., &c., du Vicentin, p. 32. |
| nec — — — | <i>Bast.</i> | 1825. | Desc. des coq. foss., &c., de Bord., p. 39. |
| nec — — — | <i>Bronn.</i> | 1831. | Italiens tertiärgeb., p. 12, No. 5. |
| nec — — — | <i>Pusch.</i> | 1837. | Polens Palæont., p. 115, No. 2. |
| nec — — — | <i>Grat.</i> | 1838. | Cat. zool., &c., de la Gironde, p. 47, No. 422. |
| nec — — — | <i>Ib.</i> | 1838. | Tabl. statist. &c., de l'Adour, t. 19, No. 22. |
| nec — — — | <i>Ib.</i> | 1840. | Conchyl. foss., &c., de l'Adour, t. 2, figs. 18, 19. |
| nec — — — | <i>Sismon.</i> | 1847. | Synop. method., &c., Pedem. Foss., p. 44. |
| nec — — — | <i>Sow.</i> | 1850. | Dixon's Geol., &c., of Sussex, p. 108, t. 8, fig. 9. |

C. testá turbinatá, elongatá, lævi, ad basin transversim obsolete sulcatá; spirá promi-nulá, acutiusculá: anfractibus numerosis, angustis, angulatis, marginibus posticis depressis, strias tenues concentricas gerentibus; ultimo anfractu regulariter conoideo, sursum dilatato: aperturá angustá; labro tenui, simplici, valde arcuato, postice profunde emarginato.

Shell oblong, turbinate, with a moderately elevated mucronate spire, variable in height, but rarely exceeding a fourth part of the whole length of the shell, and terminating in a smooth, conical pullus, formed of three volutions; whorls numerous (10—12, exclusive of the pullus), bluntly angulated at the shoulders, nearly straight on the sides, with the posterior margins depressed, narrow, somewhat concave, and concentrically lined; the concentric lines are usually four or five in number, sharp, irregular, unequal, separated by moderately deep, rounded furrows, and frequently decussated by the lines of growth. In some specimens the early whorls are very finely tuberculated on the shoulders, and concentrically sulcated; the tubercles, however, disappear after the third or fourth volution, and the shoulders are afterwards smooth and simple: the concentric furrows also become gradually effaced on the posterior portion of the whorls as the shell approaches maturity, and ultimately are altogether lost, leaving only a few very obscure waved furrows traversing the base of the shell. The last whorl is conical, much attenuated in front, with nearly straight sides; the aperture is linear and narrow; the outer lip, which is thin, sharp-edged and much arched, presents a shallow but wide curvature at the posterior extremity.

M. Deshayes states that traces of the natural colouring are sometimes found in the French shells, consisting of narrow, transverse bands, occasionally interrupted by irregular, zigzag patches, following the direction of the lines of growth. Similar traces appear, though very rarely, in the English specimens.

This species appears to be confined to the middle eocene strata; for the shells from Ronca (Vicent.), described by Brongniart as *C. deperditus*, D'Orbigny regards as belonging to a distinct species, which he has named *C. Brongniartii*, and to this species the shells described by Bellardi from the nummulitic beds at Nice, probably are also referrible. Subsequent comparison has shown that specific differences also exist in the various shells from the more recent deposits which have been referred to the

present species. Thus the Sub-apennine shells, described by Brocchi, and those from Perpignan and Cassel, recorded by Sismonda, have been separated by Bronn under the name *C. Brocchii*; while to those from Dax and Gaas, described by Grateloup, M. D'Orbigny has given the name *C. Grateloupi*; and he has referred to the same species certain shells described by Pusch, to which Eichwald had given the name *C. argillacola*. The cones described by Mr. Sowerby as belonging to the present species are young shells of *C. diadema*.

Dr. Beyrich ('Die Conchylien des Norddeutschen tertiärgebirges,' vol. i, p. 24) has described some shells from the North German tertiaries, which he has referred to *C. Allioni* (Michel.), but which agree so well with the present species, that it is difficult to separate them. That author states that, in *C. deperditus* of the Paris basin, the shells are comparatively wider, the concentric lines on the margins of the whorls more strongly marked, and the angles at the shoulders sharper than in the German specimens. These differences do not appear to be greater than may be fairly attributed to variations of local conditions, and I have therefore cited Dr. Beyrich's shell, but with a query. The English shells are wider, and appear to have attained a greater size, than the French shells; and the edges of the shoulders, instead of being somewhat sharp and elevated, as in the latter, are rounded or flattened obliquely; in all other respects our shells agree so well, that I have no doubt of their specific identity.

Size.—Axis, $2\frac{1}{2}$ inches, nearly (63 millim.); diameter, 1 inch and 5-12ths (36 millim.).

Localities.—Bracklesham Bay, Bramshaw (New Forest), at which places they are not uncommon. *French*—Grignon, Parnes, Mouchy, Courtagnon, &c. (fide *Desh.*) *Belgian*—Afflighem (fide *Galeotti*), Rouge-Cloître, Saint Josse-ten-Noode and Groenedael (fide *Nyst*). *German*—Westeregeln in Magdeburgh, Hermsdorf, Freinwalde and Buckow, and Freden, near Alfeld (fide *Beyrich*). *Italian*—La Palarca (fide *Bellardi*):

No. 126. *CONUS VELATUS*, Sowerby. Tab. XXIV, fig. 12.

CONUS VELATUS, Sow. 1841. Min. Con., vol. vii, p. 27, t. 623, fig. 7.

— — *Morris*. 1843. Cat. Brit. Foss., p. 143.

— — *Sow*. 1850. Dixon's Geol., &c., of Sussex, pp. 108 and 189, t. 8, fig. 17.

— — *Morris*. 1854. Cat. Brit. Foss., p. 244.

C. testá lævi, oblongá, turbinatá, antice sub-productá; transversim obsolete sulcatá; spirá conicá, prominulá, trientem totius testæ longitudine paulo superanti: anfractibus angulatis, inermibus; marginibus posticis declivis, sub-concavis, lineas concentricas et rugas

curvas obliquas sese decussantes gerentibus, ad suturam incrassatis, plicatis: aperturá angustá; labro valde arcuato, postice late emarginato.

Shell smooth, oblong, turbinate, somewhat produced at the base, where it presents traces of transverse sulcation: spire conical, slightly elevated, barely exceeding in height a third part of the whole length of the shell: whorls narrow, angulated, and smooth round the shoulders; the posterior margins much depressed, very slightly concave, and presenting four or five rather coarse, raised, concentric lines, which are crossed and decussated by prominent, curved, wrinkle-like elevations, corresponding with the curvature in the outer lip; the edge is thickened, and presents a raised border round the suture, plicated by the extension of the marginal wrinkles over the surface. The aperture is narrow; the outer lip much arched, and separated from the suture by a wide, moderately deep curvature. The surface of the shell is much eroded, and the lines of growth are consequently more conspicuous than is usually the case; these, with the decussated lines on the spire, "give the shell," Mr. Sowerby says, "the appearance of having been enclosed in a net or net-veil; whence the name."

The specimen from which the figure is taken, and on which the species was founded, forms part of Mr. Bowerbank's collection, and is, I believe, unique. In the general character the shell resembles *C. deperditus*; but the more elevated posterior margins, the thickened and plicated edges of the whorls in the present species, apparently justify the separation.

Size.—Axis, 1 inch and 4-12ths; diameter, 5-12ths of an inch.

Locality.—Bracklesham Bay.

No. 127. *CONUS LAMARCKII*, *F. E. Edwards*. Tab. XXV, fig. 3 *a—c*.

CONUS ANTEDILUVIANUS, *Desh.* (nec *Brug.*, nec *Lam.*) 1824—37. *Descr. des coq. foss.*, &c., vol. ii, p. 749, t. 98, figs. 13, 14.

— — — *Bronn.* 1838. *Lethæa Geog.*, p. 1118.

— *DEPERDITUS*, *Sow.* (non *Brug.*), 1850. *Dixon's Geol.*, &c., of Sussex, p. 108, t. 8, fig. 9.

— *ANTEDILUVIANUS*, *D'Orb.* 1850. *Prod. de Paléont.*, vol. ii, p. 355, No. 335.

— *CONCINNUS*, *Phil.* (non *Sow.*) 1846. *Tert. foss. Magdeb.* (Paleont., vol. i, p. 80, No. 183).

— — — *Beyr.* (non *Sow.*) 1853. *Die Conchyl. des Norddeutsc. tertiärg.*, vol. i, p. 21, t. 1, fig. 2.

C. testá oblongo-turbinatá, levi, ad basin transversim sulcatá; spirá elevatá, acuminatá, trientem totius testæ longitudine superanti: anfractibus angustis, nodulosis, marginibus posticis oblique depressis, sub-concavis, ad suturam tenuiter plicatis; anfractu ultimo conico: aperturá lineari, angustá; labro tenui, arcuato, postice emarginato.

Var. FILIFER. *Testá latiori; marginibus posticis anfractuum concentrice lineatis; lineis irregularibus, aliquando granulatis.*

Shell oblong, inversely conical, smooth, with an elevated, nearly conical spire, in height a little exceeding a third part of the whole length of the shell, and terminating in a small pointed pullus of three volutions. The whorls, 8—10 in number, exclusive of the pullus, are narrow, angulated at the shoulders, the posterior margins slanting backwards towards the preceding whorl, and concave; the sutural edge finely plicated by the strongly marked lines of growth. The early whorls present on the shoulders a row of small rounded tubercles, which are continued, more or less, on the later whorls, in different individuals. The aperture is straight and narrow; the outer lip thin, sharp-edged, not much arched, and separated from the suture by a wide, shallow curvature.

In the specimens from Bracklesham Bay, forming the variety *filifer*, the shells are wider than in the type, the posterior margins of the whorls present concentric lines, variable in number, and occasionally finely granulated where they are decussated by the lines of growth, and a single row of very small, bead-like knobs runs round the sutural edge, instead of the plication usually found there, in this respect somewhat resembling *C. concinnus*. The specimens from Bramshaw agree better with the French shells than do those from Bracklesham Bay; in the latter the shells generally are somewhat wider, the tubercles on the angles of the whorls disappear more early, and the shoulders are blunter than in the typical form. I regard these differences, however, rather as merely local variations than as sufficient to justify the separation of the shells from the present species, with which they agree in the elevated spire, the slanting concave margin and crenulated edge of the whorls, and the size of the shell itself.

With regard to the nomenclature of the French shell, much confusion has arisen, the origin of which is explained by M. Deshayes in a note in the 2d edition of Lamarck's 'Histoire Naturelle' (vol. xi, p. 155). From this it appears that the shell described by Bruguière as having been found at Courtaignon, and to which he gave the name *C. antediluvianus*, was, in fact, a Sub-apennine shell, and that Lamarck, misled by this, quoted *C. antediluvianus* as a Paris-basin species in his Mémoire, published in the 'Annales du Musée.' In 1814, Brocchi, in his work, applied the name given by Bruguière to the Sub-apennine shells, to which it strictly and properly belongs; but Lamarck, in 1822, in the first edition of his 'Histoire Naturelle,' again recorded Bruguière's species as occurring in the environs of Paris. Subsequently, M. Deshayes, in his 'Description des coquilles fossiles,' &c., pointed out the fact that Bruguière's description referred to an Italian species not found in the Paris basin; but unfortunately, in describing the French Eocene shells, he applied Bruguière's name to them. Bronn also, in the 'Lethæa Geognostica,' retained the name *C. antediluvianus* for the Paris-basin species, erroneously associating it with *C. concinnus* (Sow.), a species perfectly distinct; and he proposed the specific name *C. Apenninicus* for the Sub-apennine shells. The same author subsequently, in his 'Index Palæontologicus,' again united

the so-called *C. antediluvianus* of the Paris basin with the English *C. concinnus*, retaining for them the name of the latter. It is obvious that the name *antediluvianus* belongs to the Sub-apennine shell, and cannot be applied correctly to the French eocene species; and the attempts of MM. Bronn, Nyst, and others to remove the difficulty by giving a new name to the Italian species, can but increase the confusion. Dr. Beyrich, who fully appreciated the specific distinctness of the forms, has observed ('Die Conchyl.,' &c., p. 20), that "there will not be any necessity for a new name for the older eocene species of the Calcaire Grossier if the union proposed by Bronn be adopted." In the description of *C. concinnus*, I have stated the characters in which I consider that species to be perfectly distinct; and it is a cone which, although recorded by Mr. Sowerby as occurring at Barton, is, I believe, peculiar to the older eocene strata, and cannot be associated with the present species. It becomes necessary, therefore, to give a new name to the middle eocene species, and I propose to distinguish it as *C. Lamarckii*.

Size.—Axis, 1 inch and 7-12ths (40 millim.); diameter, 9-12ths of an inch, nearly (18 millim.).

Localities.—Bracklesham Bay, Bramshaw. *French*—Parnes, Mouchy, Courtagnon (fide *Desh.*); Vaudancourt, Hermes (fide *D'Orb.*).

NO. 128. *CONUS CONCINNUS*, Sowerby. Tab. XXIV, fig. 13 *a—c*.

CONUS CONCINNUS, *Sow.* 1821. Min. Con., vol. iii, p. 180, t. 302, fig. 2.

— — *Morr.* 1843. Cat. Brit. Foss., p. 142.

— — *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 356, No. 337.

Nec — — *Phil.* 1846. Tert. Foss. Magdeb. (Palæont., vol. i, p. 80, No. 183).

nec — — *Beyr.* 1853. Die Conchyl. des Norddeutsc. tertiärg., vol. i, p. 21, t. 1, fig. 2.

C. testá elongato-turbinatá, lævi, ad basin concentrice sulcatá; spirá elevatá, sub-conica: anfractibus angustis, sub-planis, angulatis, ad angulos nodulosis; marginibus posticis declivis, duas vel tres lineas elevatas granulatas gerentibus, ad suturas marginatis, plicatis vel moniliferis: aperturá angustissimá; labro valde arcuato, postice late emarginato.

Var. β. Testá spatiis inter suturas et angulos anfractuum tres vel quatuor lineas elevatas simplices gerentibus.

Shell elongate, turbinate, concentrically furrowed at the base; spire elevated, but variable in height, sometimes nearly equalling a half, sometimes not much exceeding a third part, of the whole length of the shell: whorls seven or eight, exclusive of the pullus, very narrow, nearly straight on the sides, angulated at the shoulders, with the posterior margins slanting backwards; the edges round the suture thickened, and either plicated or furnished with a single row of rather small bead-like nobs; the space

between the edge and the shoulder is straight, and ornamented with two or three concentric raised lines, very finely granulated. The shoulders bear a single row of prominent, round tubercles, placed at regular and not distant intervals, and continued throughout. The aperture is straight, and very narrow; the outer lip much arched, and presenting a wide, shallow curvature at the posterior extremity. The concentric furrows cover the whole surface of the young shell, but become more or less effaced as the shell is enlarged, and on the last whorl they are confined to the anterior portion of the shell; through all stages of growth the basal furrows are deep and sharp-edged.

A variety occurs at Lee, near Southend, in which the sutural edge and margin of the whorl present four thick, prominent lines, rounded and smooth on the upper surface, and devoid of the granulations which characterise the type.

I have already noticed the fact, that Bronn has regarded the present species, apparently confined to the lower eocene strata, as identical with the so-called *C. antediluvianus* of Lamarck; and Dr. Beyrich, adopting that opinion, has applied the name *concinus* to a shell from the German Tertiaries which belongs to *C. Lamarkii*. The narrower form, the smaller number of the volutions, the large rounded tubercles on the shoulders, the more depressed margins of the whorls, with their thickened edges and concentric rows of granulations, or strong elevated lines, and the deep, sharp-edged furrows, barely effaced on the posterior part by the outer coating of the shell,—appear to me sufficiently to distinguish the present shells from those of the middle eocene epoch. I do not agree, therefore, with M. Bronn and Dr. Beyrich, in referring both to the same species; and in this view, apparently both M. Deshayes and M. D'Orbigny concur.

Size.—Axis, 1 inch and 3-12ths (32 millim.); diameter, rather more than 6-12ths of an inch (between 13 and 14 millim.).

Localities.—Highgate; Fortess Green, near Kentish Town; Lee, near Southend. Mr. Sowerby cites Barton, but I have never met with any specimen from that locality; and the specimen on the authority of which Barton is cited ('Min. Con.,' t. 302, lowest fig.) does not present the characteristic form of *C. concinus*; it is much mutilated, but it has rather the appearance of a worn specimen of *C. scabriculus*. M. Deshayes (2d edit. of 'Lam. Hist. Nat.') states that this species occurs in the environs of Paris; it is not mentioned, however, in his 'Description des Coquilles Fossiles,' and M. D'Orbigny has not given any French locality for it. At present this cone appears to belong exclusively to the earlier eocene fauna.

No. 129. *CONUS SCABRICULUS*, Solander. Tab. XXIV, fig. 9 *a—c*.

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| | | <i>CONUS SCABRICULUS</i> , Sol. 1766. Brand., Foss. Hanton., p. 15, t. 1, fig. 21. |
| — | — | <i>Sow.</i> 1821. Min. Con., vol. iii, p. 180, t. 303, figs. 1, 2. |
| — | — | <i>Desh.</i> 1824-37. Descr. des coq. foss., &c., vol. ii, p. 751, t. 98, figs. 17, 18. |
| — | — | <i>Ib.</i> 1845. Lam., Hist. Nat., 2d edit., vol. ii, p. 158, No. 11. |
| — | — | <i>D'Orb.</i> 1850. Prod. de Paléont., vol. ii, p. 416, No. 1472. |
| non | — | <i>Sism.</i> 1847. Syn. Meth., &c., Pedemont. foss., p. 44. |

C. testá utrinque conicá, antice sub-productá, lineis concentricis, elevatis, ornatá; spirá elevatá, acuminatá; lineis concentricis acutis, denticulatis, aliquando confertis, aliquando distantibus; alternis sæpissime minoribus, sæpe inermibus: anfractibus planis, postice obtuse angulatis; marginibus sub-concavis, ad suturam granulosus: aperturá lineari, angustá, bessem totius testæ paullum superanti; labro tenuissimo, leviter arcuato, postice sinuoso.

Shell oblong, doubly conical, slightly produced at the base, and ornamented with concentric raised lines; spire elevated, pointed, terminating in a very small conical pullus, formed of three smooth volutions. The concentric lines are sharp, and very variable in their character; sometimes numerous, sometimes distant, and very frequently the alternate lines are smaller than the others. Most generally the concentric lines rise, at regular intervals, into short, tooth-like tubercles, having their bases prolonged, both in front and behind, into short, rounded ribs, more or less prominent according to the size of the tubercles, and separated by deep, pit-like hollows. The whorls, exclusive of the pullus, are six or seven in number, flat at the sides, slightly contracted towards the base, obtusely angulated at the shoulder, longitudinally ridged by regular conspicuous lines of growth, and bordered at the suture by a row of small granulations; the space between the shoulder and the suture is traversed by two or three smooth, prominent lines. The aperture is straight, narrow, slightly emarginate in front, and in length, rather more than two thirds of the whole shell; the outer lip is smooth within, thin, sharp on the edge, of a flattened elliptical form, and separated from the preceding whorl by a moderately wide, but not deep, sinus. The columella is slightly curved inwards.

Not infrequently, the alternate smaller lines, where they do occur, are smooth and simple; and the same character sometimes, although very rarely, distinguishes the whole transverse lineation. In the latter instances the surface of the shell between the raised lines is flat and smooth, except where it is ridged by the lines of growth.

This pretty and well-marked species is, apparently, confined to the middle eocene strata; and the shells referred to it by Sismonda, from Piedmont and Turin, are considered by M. D'Orbigny to belong, in fact, to Michelotte's *C. ornatus*.

Size.—Axis, 4-5ths of an inch; diameter, rather more than 3-10ths of an inch.

Localities.—Barton. *French*—Monneville (fide *Desh.*), Chavançon (fide *D'Orb.*).

No. 130. *CONUS LINEATUS*, Solander. Tab. XXIV, fig. 10 *a—c*.

- CONUS LINEATUS*, Sol. 1766. Brand., Foss. Hanton., p. 15, t. 1, fig. 22.
 — *CORCULUM*, Sow. 1841. Min. Conchol., vol. vii, p. 27, t. 623, figs. 8, 9.
 — *LINEATUS*, Morris. 1843. Cat. Brit. Foss., p. 143.
 — *CORCULUM*, Morris. 1843. Cat. Brit. Foss., p. 142.
 — — Sow. 1850. Dixon's Geol., &c., of Suss., p. 109.
 — *LINEATUS*, D'Orb. 1850. Prod. de Paléont., vol. ii, p. 355, No. 334.
 — — Morris. 1854. Cat. Brit. Foss., 2d edit., p. 244.
 — *CORCULUM*. *Ib.* 1854. Cat. Brit. Foss., 2d edit., p. 243.
 non — *LINEATUS*, Chemn. 1795. Conchyl. Cab., vol. x, p. 27, t. 138, fig. 1285.

C. testá utrinque sub-conicá, lineis concentricis ornatá, antice sub-productá; lineis concentricis æqualibus, lævibus, confertis; spirá elevatá, acuminatá, sub-nodulosá: anfractibus planis, postice obtuse angulatis, marginibus sub-concavis, concentrice lineatis, ad suturam depressis, granulatis: aperturá lineari, angustá, longitudine bessem totius testæ fere æquanti; labro tenuissimo, leviter arcuato, postice sinuato.

Shell oblong, doubly conical, ornamented with transverse raised lines; spire elevated, coronated, terminating in a small pointed pullus, consisting of two or three smooth volutions; the transverse lines are smooth, regular, numerous, and separated by rather deep, rounded furrows; the whorls, which are five or six in number without the pullus, are flat at the sides, slightly contracted and produced in front, angulated at the shoulders, and depressed at the sutural margins, forming a narrow ledge running round the spire, the outer edge of which is finely granulated; the space between the margin and the shoulder is slightly concave, and presents two or three faint, concentric, unequal, raised lines. The early whorls bear on the shoulders a row of transverse, oblong tubercles, imparting a somewhat nodulous character to the spire, but lost on the last whorl, the shoulder of which is smooth. The aperture is straight, narrow, and about two thirds of the whole shell in length; the outer lip, which is but slightly curved, presents a shallow sinus at the posterior extremity; the columella is nearly straight.

Brander's shell, deposited in the British Museum, is unfortunately mislaid, and I have not been able to compare with it the shells now described. They agree, however, with Solander's description and figure in all respects except in the striation. Brander's shell, which was apparently a larger and an older specimen than any I possess, and was probably somewhat worn, is described as *obsolete striata*; while the transverse lines on my specimen are generally bold and clearly defined.

The Bracklesham Bay shell, described by Mr. Sowerby as *C. corculum*, is a little shorter in the spire; but, in all other respects, it agrees exactly with the present species, to which, therefore, I have referred it.

Lamarck, and, since his time, MM. Deshayes and D'Orbigny, have considered *C. lineatus* as identical with *C. stromboides* (Lamk.), from the Paris basin. These two shells do not appear to me, however, to be referable to the same species, for in the French species the shell is narrower, the spire more elevated, and formed of more numerous volutions; the whorls, also, are more rounded at the shoulders, the transverse lineation is feebler and more irregular, and the outer lip is more strongly arched than in the English shells. I have, therefore, not cited *C. stromboides* as a synonym of the present species.

So closely does *C. lineatus* resemble *C. scabriculus*, from which, in fact, it is only distinguished by its smooth, crowded, concentric lines, separated by rounded furrows, that it ought, perhaps, to be regarded as merely a variety into which the smooth lined specimens of the latter species would lead; but, without an examination of Brander's shell, I do not venture to question Solander's species.

Size.—The dimensions of my largest specimen are—axis, 7-12ths of an inch; diameter, rather more than 3-12ths of an inch: those of Brander's shell were, according to the figure—axis, 10-12ths of an inch; diameter, rather more than 5-12ths of an inch.

Localities.—Barton, Bracklesham Bay. Very rare.

Section—CONORBIS.

No. 131. CONUS DORMITOR, *Solander*. Tab. XXIV, fig. 11 *a—c*.

CONUS DORMITOR, *Sol.* 1766. *Brand.*, *Foss. Hanton.*, p. 16, t. 1, fig. 24.

— — *Sow.* 1821. *Min. Con.*, vol. iii, p. 179, t. 301.

— — *Morris.* 1843. *Cat. Brit. Foss.*, p. 143.

— — *D'Orb.* 1850. *Prod. de Paléont.*, vol. ii, p. 356, No. 338.

— — *G. Sow.* . *Gen. of Shells*, *Conus*, fig. 8.

C. testá crassiusculá, fusiformi; utrinque conicá, concentricè lineatá, antice sub-productá, vix emarginatá, paulo retroflexá; lineis concentricis elevatis, æqualibus, irregularibus, subdistantibus; interstitiis concavis, lineis incrementi tenuissime crenulatis: aperturá lineari, angustá; labro acuto, rotundato-elliptico, intus incrassato, postice late sinuato; labii margine anteriori elevatá, productá.

Var. SEMINUDA. *Testá ad basin transversim sulcatá; anfractibus postice unico sulco exaratis, cæterum lævibus.*

Shell rather thick, fusiform, resembling two nearly equal cones, placed base to base, and ornamented with concentric raised lines; the spire, forming the shorter cone, is elevated, pointed, and terminates in a very small conical pullus of three volutions; whorls

seven or eight, exclusive of the pullus, rounded at the shoulders, nearly straight on the sides, somewhat produced in front, and very slightly bent backwards. The concentric lines are equal, not very distant over the middle of the whorls, but varying in that respect in different individuals; more crowded at the base and on the shoulders, distant on the posterior margins, which are much elevated, and pressed against the preceding whorls; occasionally on the last whorl of mature specimens additional faint lines appear. The spaces between the lines are very slightly concave, and finely crenulated by the lines of growth, which are very perspicuous over the whole surface of the shell. The aperture is narrow, straight, except at the base, where it is a little deflected, and scarcely emarginate; the outer lip thin and sharp on the edge, very much thickened within, faintly crenulated on the inner margin by the concentric lines, of a roundedly elliptical shape, and detached from the suture by a wide but very shallow curvature. The anterior margin of the columellar lip is elevated and prolonged in front, where it serves as the wall of the rudimentary anterior canal formed by the produced base of the shell.

In specimens from Brockenhurst and Lyndhurst, the middle and upper parts of the whorls are perfectly smooth, with the exception of a single furrow which traverses the posterior margins; and the base of the shell presents numerous shallow furrows, which extend almost up to the middle of the whorl, instead of the sharp elevated lines which characterise the typical form.

This well-known species, peculiar, I believe, to the Hampshire basin, forms the type of Mr. Swainson's genus *Conorbis*. In the elevated conical spire, the almost semicircular form of the outer lip, and the produced base of the whorls, it presents the closest analogies with that section of the *Pleurotomæ* formed of *P. prisca*, *P. amphiconus*, *P. linearis*, and similar species. Indeed, so closely does it approach to some of these, that, judging from external characters only, it is difficult to decide to which genus it should be referred. The straight, narrow aperture, however, is certainly that of a cone, and indicates a necessity that the animal, in order that it might withdraw into the inner whorls, should be enabled to enlarge the space within the shell; a necessity which, as I have already stated, was met by the power of absorption possessed by the animal. The curvature in the outer lip, also, is quite distinct in its character from the sinus in the outer lip of the *Pleurotomæ*.

Size.—Type—Axis, 1 inch and 1-12; diameter, 5-12ths of an inch. Var.—Axis, 1 inch and 3-12ths; diameter, 6-12ths of an inch.

Localities.—Barton, Alum Bay (No. 29, *Prestwich*), Lyndhurst, and Brockenhurst (New Forest).

No. 132. *CONUS ALATUS*, *F. E. Edwards*. Tab. XXV, fig. 1 *a, b*.

C. testá sub-fusiformi, utrinque conicá, concentrice sulcatá, antice sub-productá, retro-flexá, emarginatá; spirá acuminatá, in longitudine trientem totius testæ superanti: anfractibus convexiusculis, sub-angulatis; marginibus posticis angustis, concavis, concentrice sulcatis; sulcis concentricis irregularibus, postice evanescentibus: aperturá angustá; labro aliformi, fere semicirculari, acuto, intús incrassato, antice crenulato, postice perparum breviterque emarginato; labio antice reflexo, producto.

Var. HEMILISSA. Testá breviori, latiori, postice lævi; marginibus anfractuum valde cavatis, unico sulco concentrico exaratis.

Shell nearly fusiform, doubly conical, concentrically furrowed, rather produced and bent backwards at the base, and deeply notched; the concentric furrows are irregular, crowded, and sharp-edged over the base, more distant and obscure as they ascend the shell; the spire is pointed, elevated, rather more than a third part of the whole shell in height, and terminates in a very small, conical pullus. The whorls are rather convex, slightly angulated at the shoulder, and a little thickened on the edge round the suture; the posterior margin is narrow, rather concave, and traversed by two or three deepish furrows. The aperture is narrow and nearly straight, with the anterior extremity slightly curved outwards and backwards; the outer lip is remarkably large, almost semicircular, thickened within, thin and sharp on the edge, and separated from the suture by a very small but rather deep curvature; the inner lip produced, reflexed, and curved backwards; the columella presents a broad, elevated ridge or "crest" in front.

A variety occurs at Brockenhurst, in which the shell is shorter and wider; the posterior portion of the whorl is smooth; the angle on the shoulder sharper and more clearly defined, and the posterior margin more concave, and traversed by a single obscure furrow.

The presence, in this species, of concentric furrows instead of the sharp, elevated lines which characterise *C. dormitor*, is not a character to which much specific value can be attached, as these ornaments interchange by insensible degrees; but the depressed, concave posterior margin of the whorls, the very large wing-like, outer lip, the small, narrow, but deep curvature which separates the outer lip from the suture, and the deep anterior notch, with its usual accompaniment, the elevated crest on the columella, appear to me to justify the separation of the present species. Even the variety which, with its half-smooth half-sulcated surface, so much resembles the *var. seminuda* of *C. dormitor*, is easily distinguishable by these characters.

Size.—Type—Axis, 1 inch and 5-12ths, nearly; diameter, rather more than 6-12ths of an inch. Variety—Axis, 1 inch; diameter, $\frac{1}{2}$ inch.

Localities.—Type: Bramshaw. Variety: Brockenhurst, Lyndhurst.

Genus 26th. PLEUROTOMA.* *Lamarck.*TURRIS, 1797, *Humphreys.*PLEUROTOMA, 1801, *Lamarck.*PLEUROTOMARIUS, 1806, *Dumér.*PLEUROTOMUS, 1810, *De Montf.*TURRICULA, 1817, *Schum.* (not *Klein*).PLEUROTOMA, 1840, *Swainson.*— (exc. sect. A) 1847, *Bellardi.*SURCULA, 1853, *Adams.*GENOT, 1757, *Adanson.*CRASSISPIRA, }
BRACHYTOMA, } 1840, *Swains.*CONOPLEURA, 1844, *Hinds.*GENOTA, 1853, *Adams.*Sect. DRILLIA, 1834, *Gray.*

Gen. Char.—*Shell* fusiform, turreted, or conoid, ribbed or concentrically striated, sometimes smooth; spire elevated: aperture oval, terminating anteriorly in a canal more or less elongated; outer lip thin, with a deep fissure or notch near the posterior extremity; columella smooth, nearly straight. *Operculum* pointed, nucleus apical.

This genus, first indicated by Humphreys under the name *Turris*, was established by Lamarck for various shells, which by Linnæus, Chemnitz, and others, had been placed with *Murex*, and by Brugnière with *Fusus*. The animal is very similar to that of the *Cone*, and, like it, presents a strong resemblance to those of the *Muricidæ*, from which it is mainly distinguished by the peculiar character of the dentition. It has a small, flat head, provided with a siphon varying in length, and with cylindrical tentacles wide apart, on bulgings near the bases of which the eyes are placed; and the mouth terminates in a small, fleshy proboscis. The foot is oblong, truncated at each extremity, of nearly uniform width, and thin at the edge; and the mantle has a notch or slit on the right side which corresponds with, and is represented by, the sinus in the shell. The function attributed to this notch is the more ready expulsion of the excretory matter, but the precise way in which it is subservient to that purpose is not known. Apparently it is intended, as Mr. Swainson asserts, for the protrusion of some particular organ of the animal; but the existence of such an organ is not noticed by MM. Quoy and Gaimard in their description of the anatomy of the animal of *Pleurotoma Babylonica*, nor has it as yet been ascertained. The lingual teeth are elongate, subulate, arranged in two series; but, as in the *Cone* animal, the central or rachidian teeth, usually found in other families, are wanting.

* Etym. Πλευρά, the side; and Τομή, an incision.

When Lamarck first established the present genus, he at the same time separated the species whose shells terminate in a short canal, under the name *Clavatula*, a genus which, as defined by the author, rested wholly on characters taken from the shell, and which was afterwards withdrawn by him as not tenable. In this suppression subsequent writers have concurred until recently, when, a better knowledge of the animal having been acquired, characters have been pointed out which are generally considered as sufficient to justify the separation, and the genus has accordingly been adopted, and has been re-defined by Dr. Gray. The most prominent of these characters are the shape of the foot, which is large and ovular, and the condition of the operculum, the nucleus of which, instead of being apical as in the true *Pleurotoma*, is placed nearly at the middle of the right margin. The shell also, it must be observed, presents an emargination near the anterior extremity of the outer lip, similar to that found among the *Strombidæ*, and a thick callosity at the hind part of the columella near the suture, characters which are not found in the present genus.

The genus *Pleurotoma*, as originally defined, comprised a large number of species, and the list of synonyms shows how strongly the necessity for some subdivision has been felt. Some of the proposed divisions, however, so far as the present imperfect knowledge of the animals will enable the student to estimate their value, appear to rest on conchological distinctions, and as yet are not generally accepted. In others, however, the animals exhibit distinct characters, which, taken in conjunction with modifications of the shells, are received as of sufficient generic value. Thus in *Bela* (Leach), the eyes are placed on the upper part of the tentacles, which are approximate, and the outer lip of the shell is simple, or with a slight sinus confluent with the suture; and in *Mangelia* (Leach; *Defrancia*, Millet; *Raphitoma*, Bellardi), the eyes are sub-pedicelled, the foot is short, tapering behind, and enlarged in front at each corner into a hook-shaped projection, and the dentition, according to Messrs. Forbes and Hanley, presents a simple rachidian tooth in addition to the two lateral subulate teeth of the present genus; the animal, also, is without an operculum, and the outer lip of the shell has a sinus resembling that found in the notched species of *Bela*.* Again, in *Perrona* (Schum.; *Tomella*, Swains.), the nucleus of the operculum is placed near the middle of the right side, as in *Clavatula*, of which genus, in fact, it appears to be only a smooth form; and again, in *Drillia* (Gray), according to Messrs. Adams, the eyes are placed near the lips of the tentacles, which are very slender and approximated, and the outer lip presents a small sinus in front, like the one in *Clavatula* already noticed. A more extended knowledge of the animals may hereafter support others of the proposed genera; but, in the mean time, they can be received only as subdivisions for facilitating the arrangement of the very numerous species which crowd the present genus.

* Messrs. Forbes and Hanley have united *Mangelia* and *Bela*, using the latter name to distinguish the operculated species from those without an operculum, which, with those authors, form the true *Mangelia*.

With regard to the genus *Clavatula*, several shells are found among the English eocene *Pleurotomæ*, which, agreeing with Lamarck's definition of the genus, might be, perhaps correctly, referred to it; but since that genus, as re-defined, depends on zoological characters, and on the condition of the operculum, criteria which are not available to the palæontologist, and the species themselves do not exhibit any characters by which they can be separated from the true *Pleurotomæ*, those shells have been referred, in the following descriptions, to the present genus.

Bellardi, in his elaborate and most useful work, 'Monografia delle Pleurotome fossile del Piémonte,' has divided the *Pleurotomæ* into three genera, *Pleurotoma*, *Borsonia*, and *Raphitoma*. The first comprises the true *Pleurotomæ* and the *Clavatulæ* of Lamarck; and with these are associated some fusiform shells generally referred to *Fusus*, the outer lips of which present, not the true notch or slit characteristic of a *Pleurotoma*, but a wide undulation, which the author regards as a "rudimentary sinus." No other reason is assigned, and this certainly does not appear to be a sufficient one, for placing the shells in question in the present genus. Several of the so-called eocene *Fusi* present this undulation in the outer lip; and inasmuch as to refer them to the present genus would, in my opinion, uselessly create much confusion, I have left them among the *Fusi*, where they were first placed. The second genus, *Borsonia*, is proposed for certain shells in which the true sinus of a *Pleurotoma* is associated with a fold on the columella.* The remaining genus, *Raphitoma*, consists of those species in which the sinus is very small and confluent with the suture, and the canal is indistinct, a division which corresponds pretty accurately with *Mangelia* (Leach). The *Pleurotomæ* are again divided into three sections, according to the size and shape of the sinus; namely, *Pseudotomatæ*, or false-notched shells, composed of the fusiform species before mentioned, in which the outer lip presents the so-called rudimentary sinus; *megatomatæ*, or widely-notched shells;† and *macrotomatæ*, or deeply-notched shells. The last section is again sub-divided into five groups; *deltoideæ*, in which the canal is but little produced, and the sinus is placed in an angular depression; *pteroideæ*, in which the canal is elongated, the outer lip aliform and produced in front, and the sinus is in a depression; *cariniferæ*, having the canal as long as the spire, and the sinus on a keel; *excavatæ*, in which also the canal is as long as the spire, but the sinus is between the shoulder and the suture; and *hemicycloïdales*, having the canal indistinct, and the sinus semicircular, and placed in a depression.

Although this classification will render great assistance in the study of the present

* Shells referable to this division, as enlarged by Rouault, occur in our middle eocene strata; the genus *Borsonia* will therefore be noticed in its proper place.

† Bellardi cites *Tomella*, Swains., as corresponding with his section *Megatomatæ*; that section, however, consists of two species only, *P. cataphracta*, Broc., and *P. ramosa*, Bast., in both of which the shells are many whorled, turreted, coronated, and concentrically striated, and therefore do not at all agree with Mr. Swainson's definition of his genus *Tomella*.

genus, the distinctions between some of the groups will, I think, be found to be difficult of practical application; nor will the groups proposed embrace all the forms which occur in the English eocene fauna. The employment of a few broadly marked characters, which the eye can readily seize, will afford, in fact, more effectual aid to the student; and with this view I have adopted the division of the *Pleurotomæ*, proposed by M. Deshayes, into *fusiformes* and *conoidales*; but the *fusiformes* I have divided into two sections, distinguished by the position of the sinus, a prominent and unvarying character; while the size and, to some extent, the shape of the sinus are subject to modification. The first section will comprise the species in which the sinus is placed in the margin, that is to say the space between the suture and the shoulder, or widest part of the whorl; the second section will embrace those in which the sinus is placed on the shoulder of the whorl. Each of these sections will be sub-divided into two groups, respectively consisting of the species having the canal produced, and the species in which the canal is short or indistinct.

The genus *Pleurotoma* is one of peculiar interest; it seems to form a central group, in which either the animals present close affinities with those of the neighbouring genera, or the shells, radiating through aberrant forms in which the typical characters are prominently retained, present striking analogies with those of apparently distant genera; analogies which, if not suggestive of affinities, at least show the repetition of similar forms in dissimilar groups. Thus the passage from the true fusiform *Pleurotomæ* through the conoidal forms of that genus into the species of *Cone* forming the section *Conorbis*, and so into the true Cones, is a transition so gradual and so perfect as in itself to afford the strongest evidence of the intimate connection of the present genus with the Conidæ. So, again, the passage through *Lachesis* into *Murex*—that through the shells before referred to with the so-called rudimentary sinus in the outer lip into the true *Fusus*; and also that through *Borsonia* into *Turbinella* or *Fasciolaria*; while the short posterior canal in the species forming Swainson's genus *Brachytoma*, and the anterior notch on the outer lips of the *Drillia*, present strong resemblances to the *Strombidæ*.

The living species of *Pleurotoma* are very numerous, upwards of 450, including those forming the different sub-genera, having been described: they are found in all parts of the world, but principally in the seas of China and Western America, ranging in depth from low-water mark to 100 fathoms. In the fossil state they first appear in the upper cretaceous strata, from which four species referred to this genus have been described by Goldfuss, Sowerby, and D'Orbigny. During the tertiary epoch the genus was largely developed; upwards of 90 species, from the eocene formations of Europe, have been described by Lamarck, Sowerby, Deshayes, Melleville, and other writers; while from the more recent formations nearly 200 species have been recorded by Brocchi, Grateloup, Basterot, De Koninck, Nyst, Bellardi, Sowerby, S. Wood, Hörnes, and the many other authors who have described the mollusca of the newer

tertiary deposits. In the Western hemisphere, which presents a large proportion of the living species, the genus does not appear to have had so large a development; twenty-three species only from the tertiary deposits in the United States have been described by Conrad and Lea, and three species from the newer tertiaries of Chili have been described by Sowerby. The genus is largely represented in the English eocene fauna, but as yet comparatively few species have been described or identified.

The shells of the *Pleurotomæ* appear to have been peculiarly subject to modification by external conditions, and, as De Blainville has remarked, it is "apparently with them as with the *Cerithia*, the *Ammonites*, and other genera which contain many species; each locality presents different forms."

Section I. Shells fusiform.

A. Sinus in the posterior margin of the whorl.

a. Canal elongated.

NO. 133. *PLEUROTOMA STENA*, *F. E. Edwards*. Tab. XXV, fig. 4 *a, b*.

P. testá elongato-fusiformi, angustá, sub-turritá, fasciis et filis spiralibus, lineis incrementi decussatis, omnino tectá; spirá productá, apice acuminato: anfractibus convexiusculis, angulatis, obtuse carinatis, postice sub-concavis, ad suturam crenulatis; filis concentricis numerosis, inæqualibus; anfractu ultimo antice gradatim attenuato et in canali longo, recto, exeunti: aperturá elongato-ovali; labro vix arcuato; sinu labrali angusto, profundo in margine collocato.

Shell elongate, fusiform, narrow, ornamented with numerous spiral bands, the spaces between which, as well as the surface between the shoulder and the suture, and sometimes even the spiral bands, are covered with numerous fine, thread-like, unequal, raised lines, decussated, or rather roughened, by the lines of growth; the spire, which is formed of seven or eight volutions, is much produced; the whorls are slightly convex, sharply angulated at the shoulder; the posterior margins depressed and slightly thickened at the edge, where one or two raised lines, stronger than the others, and crenulated by the lines of growth, run round the suture; the space between the suture and the shoulder is concave, giving somewhat of a turreted aspect to the spire. The spiral bands are irregular, narrow, flat on the surface, sharp edged; the posterior band runs round the shoulder, forming a blunt keel, and the space between it and the band immediately in front of it is wider than those between the other bands, and is concave; the bands, as they approach the anterior part of the shell, become closer, narrower, and less prominent, while, on the other hand, the concentric lines become stronger, more elevated, and more distant, until the two blend together, and form the round, coarse, raised lines which cover the base of the shell

and the canal. The body whorl is gradually much attenuated in front, and terminates in a long, nearly straight canal. The aperture is of a lengthened oval shape; the outer lip slightly arched; and the sinus, which is in the middle of the margin, is narrow and deep.

The young shell of the present species presents some resemblance to the variety *Pagoda* of *P. terebralis*; but the latter shell is proportionably wider and shorter, and is distinguished as well by the smooth posterior margins of the whorls as by the sharp-edged keel, which is turned upwards, forming a deep channel round the margin.

Size.—Axis, 2 inches and 10-12ths; diameter, 8-12ths of an inch.

Localities.—Highgate, Clarendon Hill, Shenfield, and Southampton.

No. 134. *PLEUROTOMA INARATA*, Sowerby. Tab. XXV, fig. 6.

PLEUROTOMA INARATA, Sow. 1850. Dixon's Geology, &c., of Sussex, pp. 102, 183, t. 6, fig. 21.

— — Morris. 1854. Cat. of Brit. Foss., 2d edit., p. 270.

P. testá elongatá, fusiformi, spiraliter lineatá; spirá conicá, acuminatá: anfractibus convexiusculis, postice sub-concavis, marginatis, ad suturam leviter crenulatis; ultimo anfractu in canali longo, angusto, subrecto exeunti; striis spiralibus numerosis, lineis incrementi decussatis, alternis vel trinis crassis, cæteris tenuibus: aperturá ovatá; labro arcuato, sinu profundo, sub-trigono, in margine collocato.

Shell fusiform, elongated, ornamented with spiral, raised lines: spire elevated, conical, pointed: whorls convex, thickened on the margin, where they present a raised border running round the suture, feebly crenulated at the edge, and traversed by two or three slender, concentric, raised lines; the space between the suture and the shoulder slightly concave, and covered with very fine, thread-like, concentric, raised lines, which are crowded near the raised border: the last whorl terminates in an elongated, nearly straight canal, almost as long as the spire. The spiral lines on the middle and front parts of the whorls are numerous, strongly decussated by the lines of growth, and unequal; every alternate or third line being thick, prominent, and sharp on the edges, and the intermediate lines thread-like and slender. The aperture is ovate, the outer lip much arched, and the sinus, which is placed in the depression between the suture and the shoulder, is deep, moderately wide, and sub-trigonal in shape.

This species appears to be the analogue of the Barton and Highcliff species, *P. rostrata*, from which it is distinguished by the absence of the tubercles and the ribs, or undulations on the shoulders.

Size.—Axis, 2 inches and 2-12ths; diameter, rather more than 8-12ths of an inch.

Locality.—Bracklesham Bay.

No. 135. *PLEUROTOMA HELIX*, *F. E. Edwards*. Tab. XXV, fig. 7 *a, b*.

P. testá elongato-fusiformi, sub-turritá, fasciis spiralibus, lineis incrementi asperatis, cinctá; spirá elevatá: anfractibus convexis; marginibus posticis latis, cavatis, lineas concentricas filiformes inæquales gerentibus, ad suturam crenulatis; fasciis spiralibus angustis, numerosis, alternatim majoribus et minoribus: aperturá elongato-ovali, in canali longo terminanti; labro valde arcuato; sinu angusto, profundo, in margine collocato.

Var. RICNA. Testá anfractibus sub-angulatis; fasciis spiralibus numerosioribus, tribus minoribus inter majores apparentibus.

Shell lengthened, fusiform, and covered with concentric bands, roughened by the strongly marked lines of growth; spire elevated: whorls convex, rounded at the shoulder, produced in front; the posterior margins wide, channeled, and bordered round the suture by two or three bands strongly crenulated; the middle of the margin presents three coarse, rounded, raised lines, and on each side of these three or more fine thread-like lines. The line of the suture is very decurrent, and runs at some distance below the wide part of the whorl, giving a screw-like appearance to the spire. The spiral bands are numerous, rounded at the edges, and unequal, the alternate ones being smaller than the others. The aperture is of a narrow, ovate form, and terminates in a longish straight canal; the outer lip is much arched, and the sinus, which is deep and moderately wide, is placed in the middle of the margin.

Specimens occur at Potter's Bar (*var. ricna*), in which the shoulders of the whorls are angulated, and a fine thread-like line runs on each of the smaller spiral bands.

The specimens figured were obtained from the railway cutting at Primrose Hill, and form part of Mr. Wetherell's collection.

Size.—The exact dimensions cannot be given, but those of the largest specimen figured must have been—axis, nearly 3 inches; diameter, 11-12ths of an inch.

Localities.—Primrose Hill and Potter's Bar.

No. 136. *PLEUROTOMA SYMMETRICA*. *F. E. Edwards*. Tab. XXV, fig. 5 *a, b*.

P. testá elongato-fusiformi, gracili, spiraliter fasciatá, in juventá costulatá; spirá elevatá: anfractibus convexiusculis, marginibus posticis vix cavatis, ad suturam marginatis, crenulatis; ultimo anfractu in canali longo exeunti; fasciis spiralibus irregularibus, lineis incrementi asperatis: aperturá ovali elongatá; labro valde arcuato; sinu mediocriter lato, parum profundo, in margine collocato.

Shell lengthened, slender, fusiform, ornamented with numerous spiral bands, and, in the early stages of its growth, obscurely ribbed: spire elevated, pointed: whorls

(8—10) slightly convex; the posterior margins narrow, very slightly depressed, rather thickened at the edges, and presenting round the suture two raised lines, obscurely granulated; in front of these, two or three fine, thread-like lines run along the middle part of the margin, granulated by the lines of growth, which are much elevated until they cross the shoulder, and give a wrinkled appearance to the margin. The spiral bands over the other parts of the whorls are numerous, irregular, and unequal; smaller ones alternating with large ones. The aperture is narrow, and of an oblong-oval form; the outer lip arched, and the sinus, which is moderately wide, and not very deep, is placed in the front part of the margin, immediately behind the shoulder.

In the ornamentation the present species resembles *P. helix*, but the narrow posterior margin, the position of the sinus, and the slight but nearly regular convexity of the whorls, giving a symmetrical appearance to the shell, distinguishes it as well from that species as from *P. crassa*.

Size.—The largest specimen figured would be, if perfect—axis, nearly 4 inches; diameter, 1 inch.

Localities.—Potter's Bar, Chalk Farm, Southampton, Shenfield.

NO. 137. *PLEUROTOMA TERETRIUM*. *F. E. Edwards*. Tab. XXV, fig. 8 *a—h*.

P. testá elongatá, fusiformi, spiraliter lineatá: anfractibus convexiusculis, marginibus posticis concavis, concentrice lineatis, ad suturam marginatis; suturis perspicuis; ultimo anfractu valde producto, in canali longo exeunti; lineis spiralibus irregularibus, alternatim funiculosi et tenuibus, lineis incrementi per-asperatis; aperturá elongato-ovali; labro valde arcuato; sinu lato, profundo, in margine collocato.

Var. NANODIS. *Testá breviori, latiori; marginibus posticis anfractuum paucillum cavatis.*

Var. CREBRILINEA. *Testá minori, graciliori: anfractibus obsolete tuberculatis, lineis spiralibus numerosis, æqualibus, fortiter decussatis.*

Var. TUBERCULATA. *Testá graciliori: anfractibus sub-angulatis, tuberculatis, ad suturam crenulatis; lineis spiralibus confertis, sub-æqualibus.*

Var. LATIMARGINATA. *Testá minori: spirá tuberculatá: marginibus anfractuum latissimis, contrá spiram expressis.*

Shell elongate, fusiform, ornamented with numerous spiral, raised lines; spire elevated, formed of 7—9 volutions: whorls somewhat convex, separated by a perspicuous suture, and much produced in front, the last whorl terminating in a long, nearly straight canal; the posterior margins concave, slightly thickened, and occasionally feebly crenulated at the edge. The spiral lines over the middle and front parts of the whorls are irregular, thickish, cord-like bands, alternating with slender, thread-like lines, and

all much roughened, almost decussated, by the lines of growth; the spiral lines on the posterior margins are numerous and nearly equal, the two or three nearest the suture being rather more prominent than the others. The aperture is of a lengthened, ovate form; the outer lip much arched; and the sinus, which is placed in the front part of the marginal depression, is deep and moderately wide. Specimens frequently occur (var. *nanodis*, fig. 8 *b*) in which the shell is shorter and wider than in the typical form, and the margins of the whorls not being so much depressed and hollowed out, give a nearly conical form to the spire; but the character of the concentric lineation, the shape and position of the sinus, and the form of the outer lip, correspond with those of the type.

Other forms also occur which, although presenting differences in the proportions or ornamentation of the shells, or in the form of the outer lip, agree in other respects so closely with the present species, that they appear to me to be merely varieties of it.

In the first of these forms (var. *crebrilinea*, fig. 8 *f*), the shell is smaller and narrower, the spire more pointed and obscurely tuberculated; the spiral lines are slender, numerous, and deeply cut by the sharp, prominent lines of growth, and the margins of the whorls are finely plicated. In the next form (var. *tuberculata*, fig. 8 *c—e*) the spire is more slender; the concentric ornamentation resembles that of the variety *crebrilinea*, but the whorls are angulated, and present a single row of slightly oblique, oblong tubercles, which are continued, in some instances, even on the last whorl of the fully formed shell. The third variety (var. *latimarginata*, fig. 8 *g, h*) resembles the preceding variety in the proportions of the shell, and the angular and tuberculated whorls, but the posterior margins are widely spread out, and pressed against the preceding whorls, which are covered by them almost up to the tubercles. In all the last three varieties, the outer lip is not so much arched as that of the typical form.

This species so closely resembles one from Tortona (*P. granulosa*, Bon.; *P. Simonæ*, Bell.), that it is difficult to separate the two. In the Italian shell, the whorls appear to be more numerous, and the posterior margins present from three to five rows of bead-like granulations near the suture; but, judging from the figure and description given by Bellardi, the two species appear to agree in the form of the whorls, the character of the spiral ornamentation, the condition of the outer lip, and the position and shape of the sinus. The differences pointed out are scarcely sufficient to justify the separation of the present species; but without an actual comparison of the shells themselves, I do not venture to identify a form from the older eocene deposits in this country with one from the pliocene formations of Italy.

Size.—Of the type; axis, 2 inches and a half; diameter, 10-12ths of an inch. Of the variety *tuberculata*; axis, 1 inch and 7-12ths; diameter, not quite half an inch.

Localities.—The species is found, in all its varieties, at Highgate; the variety *crebrilinea* also occurs at Potter's Bar and Shenfield; and the variety *tuberculata* at

Southampton, Shenfield, Clarendon Hill, Primrose Hill, Haverstock Hill, and Alum Bay (No. 4, Prestwich). In the variety *crebrilinea*, from Shenfield, the body-whorl is short, and rather suddenly contracted in front, and the lineation is very fine and nearly equal.

No. 138. *PLEUROTOMA CRASSA*. *F. E. Edwards*. Tab. XXVI, fig. 1 *a—d*.

P. testá elongato-fusiformi, longitudinaliter costulatá, spiraliter fasciatá; spirá elevatá, acuminatá: anfractibus convexis, antice subito coarctatis; marginibus posticis concavis, concentricè granuloso-lineatis, ad suturam incrassatis, oblique plicatis; suturis perspicuis; fasciis spiralibus numerosis, plus minusve latis, crassis, cum lineis concentricis filiformibus alternantibus, lineis incrementi per-asperatis: aperturá oblongo-ovali; labro leviter arcuato; sinu lato sub-triangulari in mediá margine collocato; canali antico, longo, recto.

Shell elongate, fusiform, longitudinally ribbed, and spirally banded: spire elevated, being nearly as long as half the shell, and pointed: whorls many (9—11), convex, rather suddenly contracted, and much produced in front; the posterior margins hollowed out, thickened and strongly plicated by the prominent lines of growth on the sutural edge; the ribs rounded, moderately distant, rather oblique and short, not extending, even in young shells, much in front of the shoulder, and lost on the last whorl of the fully grown shell. Several coarsish concentric lines traverse the margins of the whorls, and are decussated by the lines of growth; two or three on the sutural edges are thicker and more elevated than the others, and from the deep decussation assume the appearance of a double row of coarse granulations: the bands over the middle and front of the whorls are more or less broad, prominent, rather closely set, and separated by strong, thread-like lines, the whole much roughened by the lines of growth: the body whorl is produced in front into a long, moderately wide, and nearly straight canal. The aperture is of an oblong, ovate shape; the outer lip arched, but not much; and the sinus, which is placed in the middle of the margin, is wide and subtrigonal. Occasionally specimens occur in which the shell is wider, and the spire not so much produced; but in all other respects agreeing with the typical form.

Size.—The large specimen figured would be, if perfect—axis, 4 inches and 3.12ths; diameter, 1 inch and 4.12ths.

Localities.—Clarendon Hill, Southampton, Shenfield.

No. 139. *PLEUROTOMA PLANETICA*. *F. E. Edwards*. Tab. XXVI, fig. 3.

P. testá elongato-fusiformi, sub-turritá, undique spiraliter lineatá; spirá elevatá, acumi-

natá: anfractibus numerosis, angulatis, convexis, sub-ventricosis, in juventú tuberculatis; marginibus posticis latiusculis, concavis; ultimo anfractu in canali longo, recto, terminanti; striis spiralibus numerosis, inæqualibus, lineis incrementi asperatis; striis duobus vel tribus ad humeros prominentioribus: aperturá pyriformi; labro arcuato; sinu lato, profundo, in margine collocato.

Shell elongate, fusiform; spire much produced, pointed: whorls many (10—12), convex, somewhat ventricose, angulated at the shoulders, much attenuated, and produced in front, the last whorl terminating in a long, straight, moderately wide canal; the posterior margins are rather wide, depressed, channeled along the middle, and somewhat thickened at the edge, so as to present a broadish, slightly elevated border round the suture. The angulated shoulders, and depressed posterior margins of the whorls, give a turreted character to the spire. Two sharp, elevated, and rather distant spiral lines run round the border, and several faint and unequal lines traverse the hollow part of the margins. On the middle and front parts of the whorls the spiral lines are numerous, irregular, and unequal, a slender, thread-like line occasionally occurring between thicker and more elevated lines; two or three on the shoulder are more prominent and distant than the rest. The aperture is pear-shaped, rounded behind, contracted in front; the outer lip much arched; the sinus wide, very deep, sub-trigonal in form, and placed a little in front of the middle part of the margin.

This elegant *Pleurotoma* is apparently confined to the middle eocene strata; it has hitherto been obtained only from Bramshaw and the synchronous beds at Bracklesham Bay.

Size.—Axis, 2 inches and 9-12ths; diameter, 10-12ths of an inch.

No. 140. *PLEUROTOMA GONIÆA*, *F. E. Edwards*. Tab. XXV, fig. 10.

PLEUROTOMA TRANSVERSARIA, *Sow.* (non *Lam.*) 1850. *Dixon's Geol., &c., of Suss.*, p. 102.

— — — *Morris*. 1854. *Cat. Brit. Foss.*, 2d edit., p. 270.

P. testá elongato-fusiformi, turritá, lineis spiralibus omnino tectá; spirá elevatá: anfractibus depresso-convexis, angulatis, obscure carinatis; marginibus posticis latis, sub-concavis, ad suturam crenulatis; ultimo anfractu in canali mediocri, subrecto, exeunti; lineis spiralibus tenuibus, confertis, irregularibus: aperturá lanceolatá; labro rotundo-arcuato; sinu mediocriter lato, profundo, in margine collocato.

Shell elongated, fusiform, turreted; spire elevated, apparently much exceeding the last whorl in length: whorls rather convex, flattened at the sides, and angulated at the shoulders, which slightly project, and present the appearance of an obscure, rounded keel; the posterior margins are very wide, hollowed out, and crenulated round the suture; the last whorl contracts rather suddenly in front, and

terminates in a widish, moderately long, and nearly straight canal. The whole surface of the shell is covered with very fine, spiral, raised lines, rather distant in front, crowded, unequal, and irregular over the middle part of the whorls, where very slender, thread-like lines frequently alternate with thicker and more prominent lines; three or four faint lines run along the middle of the posterior margin, and on each side of them are several others, rather stronger and decussated by the lines of growth. The aperture is lanceolate; the outer lip large, and roundly arched; and the sinus deep, moderately wide, and placed in the very middle of the collar: the columella is slightly twisted.

The shell figured forms part of my collection, and is the specimen which Mr. Sowerby (loc. cit.) has referred to *P. transversaria* (Lam.); but the long, turreted spire, the angulated whorls, the character of the transverse lineation, the shape of the outer lip, and especially the position of the labial sinus, seem to entitle it to specific distinction. The species is very rare.

Size.—If the specimen figured were perfect, the dimensions would be—axis, 2 inches and 4-12ths nearly; diameter, 10-12ths of an inch.

Locality.—Bracklesham Bay.

No. 141. *PLEUROTOMA TRANSVERSARIA*, *Lamarck*. Tab. XXV, fig. 9 *a*, *b*.

PLEUROTOMA TRANSVERSARIA, *Lamk.* 1804. Ann. du Mus., vol. iii, p. 166, No. 6.

— — — *Ib.* 1822. Hist. Nat., vol. vii, p. 98, No. 1.

— — — *De Blainv.* 1826. Dict. des sc. nat., vol. xli, p. 389.

— — — *Desh.* 1832. Encyc. méthod. (Vers.), vol. iii, p. 796, No. 14.

— — — *Ib.* 1824-37. Descr. des coq. foss., &c., vol. ii, p. 450, t. 62, figs. 1, 2.

Nec PLEUROTOMA TRANSVERSARIA, *Grat.* 1838. Tabl. stat. des. coq., &c., de l'Adour, p. 13, No. 152.

nec — — — *Ib.* 1838. Cat. zool., &c., de la Gironde, p. 45, No. 382.

nec — — — *Ib.* 1847. Conchyl. foss., &c., de l'Adour, supp. Pleurot., t. 1, fig. 11, No. 19.

nec — — — *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 102.

P. testá elongato-fusiformi, spirá acuminatá: anfractibus convexiusculis, postice et antice tenuissime lineatis, cæterum levibus; marginibus posticis depressis, sub-canaliculatis; ultimo anfractu in canali longo, angusto, exæunti: aperturá ovatá; labro tenuissimo, arcuato; sinu mediocriter lato, profundo, in margine collocato.

Var. CYPHA (fig. 9 *b*). *Testá minori; anfractibus convexis; marginibus posticis depressioribus.*

Shell fusiform, elongated, with an elevated, nearly conical spire: whorls (10—11) slightly convex, and depressed, almost channeled, on the posterior margins; the space between the suture and the shoulder is covered with numerous, very fine, spiral,

raised lines, which, in well-preserved specimens, are decussated by the lines of growth ; the middle part of the whorl in the adult shell is quite smooth, and the body-whorl, which is rather longer than the spire, terminates in a long, narrow, nearly straight canal, ornamented with numerous, somewhat irregular, obliquely transverse, raised lines ; these lines, which are very fine and undulating, gradually become more and more feeble as they ascend the canal, and ultimately disappear towards the middle of the whorl. The aperture is ovately oblong ; the right lip very thin, and much arched ; the sinus, which is placed in the margin, just behind the shoulder, is wide and moderately deep.

In the specimens from Lyndhurst (var. *cypha*), the whorls are more convex, the posterior margins more depressed, and the outer lip less roundly arched than in the typical form, and the shells themselves are smaller ; but in the ornamentation, and in the position and shape of the labial sinus, they agree with *P. transversaria*, of which they appear to be merely local varieties.

The shells from Dax and the environs of Bordeaux, described by Grateloup, and to which M. Deshayes refers as being possibly a variety of the Paris basin species, are specifically distinct, and have been named *P. opis* by M. D'Orbigny ; and the specimen from Bracklesham Bay which Mr. Sowerby (Dixon's 'Geol.' &c.) has referred to the present species, also appears to be specifically distinct, and I have separated it accordingly under the name *P. goniæa*.

Our English specimens have attained a less size, and are somewhat narrower, than the French ones, but in all other respects they agree well.

Size.—Axis, 1 inch and 10-12ths ; diameter, rather more than 7-12ths of an inch.

Localities.—Brockenhurst, Lyndhurst. *French*—Parnes, Grignon, Chaumont (fide *D'Orb.*) ; Marquemont, Lattainville, Hermes, Neuvillebose, Saint-Felix (fide *Graves*) ; Betz, department de l'Oise (fide *De Blain*.)

No. 142. PLEUROTOMA CYMÆA, *F. E. Edwards*. Tab. XXVI, fig. 4 *a*, *b*. Tab. XXVII, fig. 9.

P. testá elongato-fusiformi, latiusculá, tuberculatá, undique spiraliter lineatá ; spirá elevatá, sub-conicá ; anfractibus convexis, angulatis ; marginibus posticis latis, vix cavatis ; tuberculis numerosis, parvis, nodiformibus, obliquis ; lineis spiralibus confertis, subtilissimis, undulosis, antice eminentioribus, postice fere obsoletis ; aperturá oblongo-ovali, in canali longo, recto, exeunti ; labro arcuato, tenui ; sinu profundo, in margine collocato.

Var. NANA. Testá minori, angustiori : canali longiori ?

Shell rather broad, fusiform, with an elevated, nearly conical spire, formed of nine or ten volutions : whorls convex, sharply angulated at the shoulders, where they present

a row of numerous, obliquely compressed, small, knob-like tubercles. The whole surface of the whorls is covered with very fine, slightly undulating, closely set, thread-like, concentric raised lines, irregular, unequal, and roughened by the lines of growth; these lines are prominent on the canal and the front part of the shell, but become more and more faint, and at last are almost effaced as they approach the shoulders of the whorls. The posterior margins are wide, very slightly channeled along the middle, and ornamented with numerous slender, concentric lines, four or five of which, running along the sutural edge, are more prominent than the rest, and are decussated by the oblique lines of growth of the sinus, forming a riband-like border to the whorls. The aperture is of an oblong, oval form, and terminates in front in a long, straight canal; the outer lip is thin, sharp-edged, and much arched; the sinus is deep, not very wide, and placed a little in front of the middle of the collar.

In the variety *nana* (Tab. XXVII, fig. 9), which is proposed for an immature specimen from Colwell Bay, in my collection, the shell is much smaller and narrower, and, apparently, the canal is more produced; but on this last point I cannot speak with certainty, as the canal is not perfect in any of the specimens of the type I have seen. In the general form of the shell, however, in the nearly conical spire, the character of the ornamentation, the position and shape of the sinus, and the roundedly arched outer lip, the specimen in question agrees so exactly with the true *P. cymæa*, that I can only regard it as a variety of that species dwarfed by unfavorable conditions.

This *Pleurotoma*, which at first sight might be considered to be a local variety of *P. dentata*, is distinguishable from that species by the greater width of the shell, the more conical spire, the wider posterior margins of the whorls, the character of the transverse ornamentation, and the numerous small, knob-like tubercles which take the place of the sharp-edged transverse teeth, characteristic of *P. dentata*. It more resembles *P. transversaria*, as well in the shape and relative proportions of the shell, as in the form and position of the sinus and the character of the concentric lineation; and a larger series of specimens may eventually lead to the conclusion that it is merely a variety of that species. The tuberculated and sharply angulated whorls, however, characters to which I am not aware that *P. transversaria* offers any approach, apparently entitle the shells in question to specific distinction.

Size.—Axis, 1 inch and 4-12ths; diameter, $\frac{1}{2}$ inch.

Locality.—Brockenhurst and Colwell Bay, at each of which places it appears to be very rare.

No. 143. *PLEUROTOMA COCCIPHORA*, *F. E. Edwards*. Tab. XXVI, fig. 2.

P. testá elongatá, fusiformi, longitudinaliter costellatá, undique spiraliter granuloso-lineatis: anfractibus convexiusculis, angulatis, ad suturas incrassatis, granulatis; marginibus posticis mediocriter latis, vix cavatis, lineas filiformes confertas gerentibus; costellis angustis; lineis spiralibus numerosis, fortiter decussatis, inæqualibus, lineis majoribus cum lineis tenuibus alternantibus: aperturá ovali; labro leviter arcuato; sinu fere semicirculari, in margine collocato.

Shell elongate, fusiform, longitudinally ribbed, and having the whole surface ornamented with spiral raised lines; spire elevated, pointed: whorls (7—9) slightly convex, angulated; the posterior margins moderately wide, nearly straight, and covered with fine, thread-like, concentric lines; two on the sutural edge are more prominent than the others, and decussated by the lines of growth so as to present a double row of fine granulations; the last whorl is produced in front into a long, and apparently nearly straight, and moderately wide canal; the costellæ are narrow, rather short, barely extending beyond the middle of the whorl, and are more or less distant in different specimens; the spiral lines over the middle and front parts of the shells are numerous and unequal, a slender, thread-like line occasionally intervening between others thicker and more prominent; all are deeply and regularly decussated by the lines of growth, so that the larger lines assume the appearance of rows of bead-like knobs. The aperture is of an oblong, oval shape; the outer lip slightly arched; and the sinus, which is placed towards the front of the margin, is wide, not very deep, and almost semicircular.

This *Pleurotoma* closely resembles the young shell of *P. crassa*, of which, if it were not for the great difference in size, it might be considered to be only a local variety; the spire, however, is shorter and more conical, the whorls more angulated, less convex and more gradually attenuated in front; the posterior margins narrower and less concave; and the sinus nearer the shoulder, and rounder than in that species. The spiral lines also, broken into rows of beads by the lines of growth, form an ornamentation quite distinct in character from the broad, coarse bands which characterise *P. crassa*.

The specimen figured forms part of Mr. Wetherell's collection.

Size.—Axis, rather more than 1 inch; diameter, 4-12ths of an inch.

Locality.—Highgate, where it is apparently very rare.

No. 144. PLEUROTOMA ROSTRATA, *Solander*. Tab XXVI, fig. 8 *a—c*.MUREX ROSTRATUS, *Sol.* 1766. *Brand.*, *Foss. Hanton.*, p. 21, t. 2, fig. 24.PLEUROTOMA ROSTRATA, *Sow.* 1818. *Min. Con.*, vol. ii, p. 104, t. 146, fig. 3.— — — *De Bl.* 1826. *Dict. des. sci. nat.*, vol. xli, p. 390.— — — *Morris.* 1842. *Cat. Brit. Foss.*, p. 157.— SUB-ROSTRATA, *D'Orb.* 1850. *Prod. de Paléont.*, vol. ii, p. 359, No. 406.— ROSTRATA? *Phil.* 1851. *Tert. Foss. Magdeb.* (*Palæont.*, vol. i, p. 64), No. 118.— — — *Morris.* 1854. *Cat. Brit. Foss.*, 2d edit., p. 270.Nec PLEUROTOMA ROSTRATA, *De Kon.* 1837. *Desc. des. coq. foss.*, &c., de Basele, Boom, &c., p. 24, No. 23.nec — — — *Nyst.* 1843. *Desc. des. coq. foss.*, &c., de la Belg., p. 522, t. 42, figs. 2, 3.nec — — — *Id.* 1843. *Bull. Soc. Géol. de France*, vol. xiv, p. 453.

P. testá elongato-fusiformi, angustá, turritá, undique spiraliter lineatá; spirá elevatá, acuminatá: anfractibus numerosis, convexis, in medio oblique tuberculatis; marginibus posticis concavis, ad suturam aliquando paulum incrassatis et cingulo duplici crenulato cinctis, aliquando simplicibus; lineis spiralibus in margine tenuibus, cæteris elevatis, rotundatis, irregularibus, inæqualibus, lineis incrementi per-asperatis: aperturá oblongo-ovali, in canali prælongo, angustato, subrecto productá; labro aliformi; sinu profundo mediocriter lato, in margine collocato.

Var. ANTIQUA. Testá latiori, breviori; anfractibus subangulatis.

Shell long, narrow, fusiform, turreted, having the whole surface covered with spiral raised lines; the spire much elevated, being nearly half the length of the whole shell, and pointed; the whorls are numerous (10—12 without the pullus), very convex, and armed near the middle with a single row of oblique tubercles, more or less prominent in different individuals; the posterior margins are moderately wide, concave, occasionally thin, and nearly smooth along the sutural edge, but more frequently slightly thickened, plicated, and ornamented with two prominent concentric lines, granulated by the lines of growth. The spiral lines in the middle of the posterior margin are close-set and very slender; over the other parts of the whorl they are prominent, rounded, irregular, unequal, small filiform lines intervening between larger ones; and all are very much roughened, almost granulated, by the lines of growth. The aperture is of an oblong, ovate form, and terminates in front in a long, rather narrow, and somewhat curved canal; the outer lip is roundedly arched and wing-like; the sinus is deep, moderately wide, subtrigonal, and placed in the middle of the margin.

In the specimens from Highcliff (*var. antiqua*, fig. 8 *c*), the shells are wider, and

proportionately shorter than in the type, and the whorls are slightly angulated at the shoulders.

Much confusion exists among several of the Continental authors with respect to this species, in consequence of the shell figured as *P. rostrata* in 'Mineral Conchology' having been considered by them as distinct from the *Murex rostratus* of Solander, although Mr. Sowerby cites the latter as a synonym. Thus M. de Koninck has described a pleurotoma from Basele and Boom, which he has referred to *P. rostrata* of Sowerby, but without having cited Brander's figure; and this pleurotoma, Nyst, after stating that it differs essentially from *Murex rostratus*, but that it is without doubt Sowerby's *P. rostrata*, regards as merely a variety of *P. Selysii* (De Kon.), to which latter species he refers it. The same author subsequently describes another species, from Basele, Boom, &c., as identical with Brander's shell, but he excludes *P. rostrata* of Sowerby. The description given by M. de Koninck agrees tolerably well with the present species; but, assuming that the shells described by that author belong, in fact, to the same species as those represented by Nyst (*P. Selysii*, t. 40, fig. 11 and *P. rostrata*, t. 42, figs. 2, 3), I do not think that any one familiar with the English shells can regard either of them as identical with the species figured by Brander, and described by Sowerby. Philippi has recorded a single specimen from Görzig, in the Museum at Halle, which he has referred to the present species. This author, however, has not given either figure or description, and as, under the circumstances to which I have referred, the accuracy of this identification cannot be assumed, I have cited Philippi with a query. At present there appears to be every reason for believing that the true *P. rostrata* of Solander is confined to the upper beds of the middle eocene formations of England; and, although Mr. Morris gives Highgate and Sheppey as localities, I am not aware of its occurrence at either of those places, nor even at Bracklesham Bay, which is also given as a locality by the same author.

Size.—Axis, rather more than $4\frac{1}{2}$ inches; diameter, not quite 1 inch.

Localities.—Barton, Alum Bay (No. 29, Prestwich), and Highcliff.

No. 145. *PLEUROTOMA KEELEI*, *F. E. Edwards*. Tab. XXVI, fig. 6.

P. testá fusiformi, turrítá, tuberculatá spiraliter fasciatá; spirá elevatá, acuminatá: anfractibus convexis, ad humeros angulatis, unicá serie tuberculorum spiniformium munitis; marginibus posticis latis, concavis, concentrice lineatis, ad suturas crenulatis; ultimo anfractu turbinato, in canali longo exeunti; fasciis spiralibus, irregularibus, inæqualibus, fasciis crassis cum aliis tenuibus alternantibus: aperturá oblongo-ovali; labro valde arcuato, sinu mediocriter lato profundo, in margine collocato.

Shell fusiform, turreted, tuberculated, spirally banded; the spire much elevated,

pointed, formed of nine or ten volutions: whorls angulated at the shoulders, and armed with a single row of large, pointed, rather distant tubercles; the posterior margins wide, concave, thickened and obliquely plicated at the suture, and ornamented with several fine concentric raised lines; of these, two running round the border are more elevated than the rest, and are decussated and feebly granulated by the plication on the edge, and two others, running along the hollow part of the margin, are also rather prominent and granulated by the lines of growth. The last whorl is somewhat turbinate, and terminates in front in a long, moderately wide, straight canal. The bands on the middle and front surfaces of the whorls are numerous, coarse, irregular, and very unequal, and much roughened by the lines of growth; three or four over the middle part of the whorls are thicker and more prominent than the rest, and between them appear two or three smaller unequal bands. The aperture is of an oblong, ovate form; the outer lip much arched; the sinus deep, moderately wide, sub-trigonal, and placed in the very middle of the margin.

This beautiful and well-marked species was first obtained from the Artesian well at Southampton, by Mr. Keele, to whom I have ventured to dedicate it.

Size.—Axis, 3 inches and 3-12ths; diameter, 1 inch and 1-12th.

Localities.—Southampton and Shenfield.

No. 146. *PLEUROTOMA DENTATA*, *Lamurck*. Tab. XXVI, fig. 5.

PLEUROTOMA DENTATA, *Lamk.* 1804. Ann. du Mus., vol. iii, p. 167, No. 8; vol. vii, t. 13, fig. 1.

— — *Ib.* 1822. Hist. nat., vol. vii, p. 99, No. 13.

— — *De Bl.* 1826. Dict. des sci. nat., vol. xli, p. 395.

— *COSTULIFERA?* *Bronn.* 1827. Zeitschrift für Mineral., band ii, p. 535, No. 120.

— *DENTATA*, *Ib.* 1831. Italiens tertiärgeb., p. 46, No. 222.

— — *Desh.* 1832. Enc. méth. (Vers), vol. iii, p. 797, t. 440, fig. 8, No. 16.

— — *Ib.* 1824-37. Descr. des coq. foss., &c., vol. ii, p. 452, t. 62, figs. 3, 4, 7, 8.

— — *Morris.* 1843. Cat. Brit. Foss., p. 157.

— — *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 102, t. 6, fig. 24.

— — *Rouault.* 1848. Desc. des foss., &c., de Pau (Mém. de la Soc. Géol. de France, 2d series, vol. iii, p. 484), No. 92, t. 16, fig. 24.

— — *D'Orb.* 1853. Prod. de Paléont., vol. ii, p. 358, No. 382.

— — *Morris.* 1854. Cat. Brit. Foss., 2d edit., p. 270.

P. testá elongatá, fusiformi, undique concentrice lineatá; spirá elevatá, acuminatá: anfractibus convexiusculis, angulatis, dentato-tuberculatis; marginibus posticis mediocriter latis, vix cavatis, ad suturas paucillum incrassatis; ultimo anfractu in canali longo termi-

nanti; striis concentricis confertis, irregularibus, in marginibus posticis tenuissimis; cæteris, striis eminentioribus cum aliis tenuibus alternantibus: aperturá angusto-ovali; labro arcuato, tenui; sinu lato, sub-trigono, in margine collocato; canali subrecto, antice reflexo, emarginato.

Shell elongated, fusiform, having the whole surface ornamented with concentric raised lines; the spire much elevated, being nearly as long as the body-whorl, pointed, and formed of ten or eleven volutions. The whorls are rather convex, sharply angulated at the shoulders, and armed with a row of transversely compressed, tooth-like tubercles, rounded in front, sharp, sometimes almost carinated at the edges, varying both in number and prominence in different individuals, and occasionally having their bases prolonged into short, rounded costellæ; the posterior margins are moderately wide, straight, or but very slightly hollowed out, and a little thickened at the sutural edges, where they are sometimes obliquely plicated by the lines of growth of the sinus; the surface between the suture and the shoulder is covered with very fine, almost obsolete, concentric lines, two of which, running round the sutural edge, are more elevated than the rest; the middle and front parts of the whorls are ornamented with numerous, irregular, undulating, thread-like, raised lines; of these some are prominent, and between them appear two or three others very slender, so much so, in fact, as to be barely perceptible by the naked eye. The aperture is of a narrow, ovate form, and terminates in a long, moderately wide, and nearly straight canal, bent backwards, and notched at the anterior extremity; the outer lip is thin, sharp-edged, and slightly arched; the sinus wide, rather deep, sub-trigonal in form, and placed in the very middle of the margin; the anterior extremity of the columella presents a prominent ridge or crest, formed by the notch of the canal.

This species is very common and widely distributed in the French formations; in England it is, apparently, confined to the middle beds of the Bracklesham Bay series. Our specimens are narrower than the French type; and in this respect and in the character of the transverse ornamentation they agree with the variety *a* of Deshayes; I have not met with the other variety recorded by that author, nor do our shells appear to have attained the size of those from the French beds. D'Orbigny, (loc. cit.) gives Claiborne, in Alabama (U.S.), as a locality. I cannot but think, however, that this identification is somewhat questionable. The present species is the type of a group of closely analogous forms, and two English species (*P. exorta* and *P. macilenta*, Sol.), which, as will be afterwards shown, are perfectly distinct, have in fact been confounded with it. No authority is cited by the author, and I have therefore given Claiborne as a questionable locality.

Size.—Axis, 1 inch and 7-12ths (40 millim.); diameter, not quite 7-12ths of an inch (15 millim., nearly).

Localities.—Bracklesham Bay; Bramshaw. *French*—Grignon, Parnes, Mouchy, Courtagnon, &c., La Chapelle près Senlis, Valmondois (fide *Desl.*), Cuise-Lamotte,

Acy-en-Mulcien, Fosse-Martin, Ermenonville, Ver (fide *Graves*), Laon (fide *Mellev.*), Bos d'Arros (fide *Rouault*). *North American* — Claiborne, Alabama (fide *d'Orb.*)?

No. 147. *PLEUROTOMA TEXTILIOSA*, *Deshayes*. Tab. XXVI, fig. 7.

PLEUROTOMA TEXTILIOSA, *Desh.* 1824-37. Desc. des coq. foss., &c., vol. ii, p. 454, t. 62, figs. 5, 6.

— — *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 417, No. 1480.

P. testá elongato-fusiformi, angustá, sub-turritá, longitudinaliter costatá, spiraliter subtilissime lineatá; spirá elevatá, acuminatá: anfractibus sub-convexis, angulatis; marginibus posticis angustis, concavis, ad suturam incrassatis; costis distantibus, obtusis; lineis spiralibus confertis, inæqualibus, lineis incrementi sub-decussatis: aperturá ovato-angustá, in canali mediocri exeunti; labro acuto; sinu lato, trigono, in margine collocato.

Shell elongate, fusiform, narrow, longitudinally ribbed and ornamented with numerous, very fine, concentric, raised lines; the spire, which is formed of eight or nine volutions exclusive of the pullus, is pointed and much produced, fully equalling the last whorl in length: the whorls are slightly convex, and angulated at the shoulders; the posterior margins narrow, hollowed out, and thickened at the edges so as to form an elevated border round the suture; the whole of the margin is covered with very fine, regular, closely set, concentric lines, of which those on the border are more conspicuous than the rest. The longitudinal ribs are rather distant, round, thick, and short, barely extending to the middle of the whorls, and terminating abruptly at the shoulders, where they present a sharp keel-like edge, which gives somewhat of a turreted aspect to the spire. The concentric lines over the front and middle parts of the whorls are very numerous, unequal, and irregular; some of them, slender and thread-like, are prominent and more or less distant, and the intermediate spaces are covered with exceedingly fine lines, scarcely perceptible by the naked eye; the whole are roughened by the lines of growth. The aperture is of a narrow, ovate form, and terminates in front in a moderately long canal, slightly notched at the anterior extremity; the outer lip is thin, sharp-edged, and expanded behind; the sinus which is wide, deep, and somewhat trigonal in form, is placed a little in front of the middle part of the posterior margin of the whorl; the columella is slightly twisted and presents a conspicuous but not very prominent crest. *M. Deshayes* states that the columella is "sub-perforated at the base," presenting there a narrow, shallow "umbilical opening, partly covered by the inner lip;" this opening, however, is not truly umbilical, but a slight hollow caused by the ridge or crest being imperfectly overlapped by the inner lip, and is a character very variable, and sometimes wanting.

The present species is an intermediate form between *P. crassicosta* and *P. dentata*; but the thick, rounded, distant ribs, the crowded transverse ornamentation, and the broader and shorter canal, render it easily distinguishable.

Size.—Axis, 1 inch and 5-12ths nearly (35 millem.); diameter, half an inch (13 millem.). The French shells attained a somewhat larger size.

Localities.—Bracklesham Bay; Bramshaw. *French*—Monneville (fide *Desh.*), Aumont, Acy-en-Mulcien (fide *D'Orb.*). It is very rare in England, but, apparently, common in the French beds.

No. 148. *PLEUROTOMA EXORTA*, *Solander*. Tab. XXVI, fig. 12 *a, b*.

MUREX EXORTUS, *Sol.* 1766. Brand., Foss. Hanton., p. 20, fig. 32.

PLEUROTOMA EXORTA, *Sow.* 1816. Min. Conchol., vol. ii, p. 104, t. 146, fig. 2.

— — *Morris.* 1843. Cat. Brit. Foss., p. 157.

— — *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 102.

— — *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 359, No. 408.

Nec PLEUROTOMA EXORTA, *Nyst.* 1835. Recher. sur les coq. foss., &c., d'Anvers, p. 28, No. 27.

nec — — *De Kon.* 1837. Descr. des coq. foss., &c., de Basele, Boom, &c., p. 22, No. 21.

nec — — *D'Orb.* 1850. Prod. de Paléont., vol. iii, p. 13, No. 195 m.

P. testá elongato-fusiformi, turrítá, undique spiraliter lineatá: spirá elevatá, subconicá, nodulosá: anfractibus convexis, prioribus obscure costellatis; ultimo anfractu subconico scilicet sensim attenuato, in canali longiusculo exeunti; marginibus posticis declivis, cavatis, ad suturam incrassatis, transversim exilissime lineatis; striis spiralibus nonnullis remotiusculis, eminentioribus, acutis; cæteris subtilissimis æqualibus: aperturá lanceolatá; labro valde arcuato, tenui; sinu lato, in margine collocato.

Shell elongated, fusiform, turreted, ornamented with spiral raised lines; the spire elevated and terminating in a small pointed pullus formed of two or three smooth volutions: whorls convex, the earlier ones very broadly and obscurely ribbed, giving a nodulous aspect to the spire; the posterior margins are somewhat thickened on the sutural edge, and but slightly depressed, so that the spire presents a nearly conical form; the space between the suture and the shoulder is channeled and covered with very fine and regular concentric lines, so slender as scarcely to be visible by the naked eye or to detract from the smoothness of the surface. On the middle and front parts of the whorls, some of the spiral lines, rather distant from each other, are sharp and elevated; the rest, which cover the intermediate spaces, are very fine, close-set, and regular, although somewhat unequally prominent. The aperture is lanceolate, and terminates in a moderately long canal, gradually diminishing in width, and thus

assuming the sub-conical form described by Solander as the chief distinction between *P. exorta* and *P. macilenta*. The outer lip is thin and much arched; and the sinus, which is wide and sub-trigonal, is placed in the very middle of the margin.

The elevated transverse line on the shoulders of the whorls, broken by the undulations caused by the ribs, occasionally presents a resemblance to the denticulation characteristic of *P. dentata*; and this circumstance probably led to *P. exorta* being considered as identical with *P. dentata*. The two species are, however, distinct; in this the shell is wider and shorter, the spire thicker and more conical, the whorls not so much angulated, the posterior margins narrower and less depressed, and the anterior canal shorter and more conical.

Nyst, in his 'Recherches sur les coquilles fossiles de la province d'Anvers,' has recorded certain shells from Boom which he has referred to the present species, and for which he has given Sowerby's diagnosis verbatim. Subsequently, De Koninck, in his 'Coquilles fossiles de Basele, Boom, &c.,' described some shells from those localities under the name *P. regularis*, and other shells he referred to the present species. These different shells, Nyst, in his later work, 'Description des coquilles, &c., de la Belgique,' considered to be merely individuals of the same species in different stages of growth, and that author referred them, erroneously as I have already shown, to *P. rostrata* (Sol.) Unfortunately I have not any specimens of the Belgian species to refer to; but, assuming that De Koninck's *P. exorta* is but the young shell of his *P. regularis*, and judging from the figures given by him of the latter species and from those given by Nyst of the so-called *P. rostrata*, it is impossible to accept the identification of the Belgian shells with the present species as correct; a conclusion at which D'Orbigny has apparently also arrived, as that author has placed *P. rostrata* (Nyst) and *P. regularis* (De Kon.) in his "26th étage," under the specific name *P. exorta* (Nyst), in forgetfulness, probably, of that name having been previously used by Solander.

Size.—Axis, 1 inch and 1-12th; diameter, 5-12ths of an inch.

Localities.—Barton, Alum Bay (No. 29, Prestwich), Highcliff, Bracklesham Bay.

No. 149. *PLEUROTOMA MACILENTA*, Solander. Tab. XXVI, fig. 13 *a, b*.

MUREX MACILENTUS, Sol. 1766. Brand., Foss. Hanton., p. 30, fig. 33.

P. testá elongato-fusiformi, angustá, turritá, undique spiraliter lineatá, longitudinaliter costatá: spirá elevatá, acuminatá: anfractibus convexiusculis, angulatis; marginibus posticis concavis, ad suturam paulum incrassatis, transversim subtilissime lineatis; lincis spiralibus numerosis, inæqualibus, quibusdam filiformibus prætenuibus, inter alias eminentiores, acutas apparentibus; costis numerosis, angustis, obliquis, fere ad caudam tendentibus: aperturá

oblongo-ovali, in canali longo, angusto exeunti; labro leviter arcuato; sinu lato, in margine collocato.

Shell long, narrow, fusiform, turreted, longitudinally ribbed, and concentrically lined: the spire, consisting of nine or ten volutions, is pointed, elevated, forming nearly a half of the length of the whole shell. The whorls are slightly convex and angulated at the shoulders; the posterior margins concave, slightly thickened round the suture, and covered with fine, thread-like, concentric lines, one or two of which near the edge are stronger and more prominent than the rest. The spiral lines over the middle and front parts of the whorls are numerous, irregular, unequal; some, more or less distant from each other, are prominent and sharp, and the intermediate spaces are occupied by two or three, occasionally by four, very slender and regular lines; the longitudinal ribs, which are rather numerous, narrow, and oblique, reach almost to the anterior canal. The aperture is oblong and ovate, and terminates in a moderately long, straight, and narrow canal; the outer lip is thin and slightly arched; the sinus wide, semi-circular in shape, and placed in the middle of the margin.

The present species, distinguished by its long costated spire, appears to be peculiar to the English middle eocene strata; DeFrance, it is true, refers to it, although with doubt, as a synonym of *P. dentata*, but a slight comparison of the shells will prevent the two species being confounded. It presents closer resemblances as well to *P. textiliosa*, as to *P. crassi-costa*; from both of these species, however, notwithstanding the similarity in the ornamentation, it may be easily distinguished by the slenderer and more numerous ribs, and the longer and narrower anterior canal.

Size.—The dimensions of my largest specimen are—axis, 1 inch and 4-12ths; diameter, 5-12ths of an inch. Those of Brander's specimen, although represented in the figure given by him as considerably larger, are, in fact, very nearly the same.

Localities.—Barton, Alum Bay (No. 29, Prestwich), Highcliff, Bracklesham Bay.

No. 150. *PLEUROTOMA CRASSI-COSTA*, *F. E. Edwards*. Tab. XXVI, fig. 10 *a, b*.

P. testá elongato-fusiformi, angustá, turrítá, costatá, undique spiraliter lineatá; spirá elevatá; anfractibus convexiusculis, angustatis; marginibus posticis latiusculis, concavis, tenuissime lineatis, ad suturam incrassatis, cingulo duplici ornatis; ultimo anfractu parvo, repente coarctato, in canali lato, longo, subrecto exeunti; costis distantibus, brevibus, crassis: lineis spiralibus confertis, inæqualibus, nonnullis eminentioribus fortibus, cæteris exilibus: aperturá oblongo-ovatá; labro leviter arcuato; sinu lato, fere semicirculari, in margine collocato.

Shell long, narrow, fusiform, turreted, ribbed, and having the whole surface ornamented with concentric lines: the spire, formed of eight or nine volutions exclusive of the pullus, is moderately elevated and pointed; whorls slightly convex, sharply angu-

lated at the shoulder; the posterior margins rather wide, hollowed out, and thickened on the sutural edge, which is bordered by two or three prominent, raised lines; the remaining surface of the margin is covered with very fine, close-set, concentric lines; the last whorl is small, and terminates in a wide and long canal, a little curved near the anterior extremity. The ribs are distant, rounded, short, not extending to the middle of the whorl, prolonged over the posterior margins almost to the suture, and bearing at the shoulders of the whorls a row of transverse tooth-shaped tubercles. The spiral lines over the middle and front parts of the whorls are numerous and unequal; some, at nearly regular and not very distant intervals, are rather thick and prominent, and between these appear two or three slender, thread-like lines. The aperture is ovate, the outer lip moderately arched, and the sinus, which is placed in the middle of the margin, is wide but not deep.

The *P. crassi-costa* bears a close resemblance to *P. dentata*, of which, perhaps, it may prove to be merely a local variety. It presents, however, certain peculiarities of form which appear to me sufficient to justify the separation. Thus the shell is narrower, the spire relatively more produced; the posterior margins of the whorls are not so wide, the whorls themselves smaller and more suddenly contracted in front, and the longitudinal ribs thicker and more distant. From *P. textiliosa* it is distinguishable by the character of the transverse ornamentation, and the thick, rounded, and more distant ribs of that species. It approaches very nearly to a species from the sables moyens, at Senlis, at present unpublished, but which M. Deshayes purposes to describe under the name *P. Michelini*, in his forthcoming appendix; without a comparison, however, with a better series of specimens of that species than I possess, I do not venture to pronounce on the identity. Should the English and French shells prove, eventually, to belong to the same species, the name proposed by M. Deshayes will be entitled to priority.

Size.—Axis, $1\frac{1}{2}$ inch; diameter, not quite half an inch.

Locality.—Bramshaw.

No. 151. *PLEUROTOMA LANCEOLATA*, *F. E. Edwards*. Tab. XXVI, fig. 11 *a, b*.

P. testá elongatá, angustá, fusiformi, spiraliter lineatá: spirá elevatá, sub-conicá, tuberculatá: anfractibus convexiusculis; marginibus posticis mediocriter latis, paucillum declivis, vix cavatis, transversim exilissime lineatis; ultimo anfractu antice gradatim attenuato, in canali longo exeunti: aperturá lanceolatá; labro valde arcuato; sinu lato sub-trigono, in margine collocato.

Shell long, very narrow, fusiform, ornamented with spiral, raised lines: the spire elevated, nearly conical, and terminating in a small, smooth, pointed pullus of two volutions: the whorls, 9—11 in number, are but slightly convex, and in the young

state are tuberculated, or roundedly costellated; the posterior margins are moderately wide, very little depressed, nearly straight, and almost smooth, or ornamented with concentric lines, so faint and slender as to be almost imperceptible without the aid of a magnifying glass; the last whorl is produced in front, and, diminishing very gradually, terminates in a long, nearly straight canal. The aperture is lanceolate; the outer lip thin, sharp edged, and much arched; and the sinus, which is very wide, and sub-trigonal in shape, is placed a little in front of the middle part of the margin.

The long, narrow, lanceolate form, and nearly conical spire of this *Pleurotoma* distinguish it from all its congeners.

Size.—Axis, 1 inch and 4-12ths; diameter, 4-12ths of an inch.

Localities.—Barton and Alum Bay (No. 29, Prestwich), where it is not very common.

No. 152. *PLEUROTOMA LÆVIGATA*, *Sowerby*. Tab. XXVI, fig. 9 *a*, *b*.

PLEUROTOMA LÆVIGATA, *Sow.* 1823. *Min. Con.*, vol. iv, p. 120, t. 387, fig. 3.

— — — *Morris.* 1843. *Cat. Brit. Foss.*, p. 157.

— — — *D'Orb.* 1850. *Prod. de Paléont.*, vol. ii, p. 359, No. 412.

Nec *PLEUROTOMA LÆVIGATUM*, *Phil.* 1836. *Enum. Moll. Sic.*, vol. i, p. 199, t. 11, fig. 17.

nec — — *LÆVIGATA*, *De Kon.* 1837. *Coq. foss. de Basele, &c.*, p. 27, No. 27, t. 1, fig. 5.

nec — — — *Meller.* 1843. *Mém. sur les sables infér., &c., de Paris*, p. 63, t. 8, figs. 9—11.

P. testá elongato-fusiformi, angustá, turritá, transversim tenuissime lineatá; spirá elevatá, acuminatá: anfractibus convexis, antice subito coarctatis, prioribus oblique costellatis; marginibus posticis angustis, depressis, sub-canaliculatis, lævibus; ultimo anfractu in canali longo, angusto, terminanti: aperturá oblongá, ovatá; labro valde arcuato, tenui; sinu lato, fere semicirculari, in margine collocato.

Shell long, narrow, fusiform, turreted, costellated, and spirally lined: the spire elevated, pointed, terminating in a pullus of two round, smooth volutions; whorls convex, rounded on the shoulders, contracted rather suddenly in front; the posterior margins narrow, depressed, slightly hollowed out, having the sutural edges thin and quite simple, and the surface smooth, almost polished, presenting only very feeble lines of growth of the sinus. The ribs are distant, rounded, oblique, and extend almost to the front part of the whorl in the young shell, but become shorter and less prominent as the shell enlarges, and altogether disappear on the body-whorl of the fully formed shell; the spiral lines are very slender, sharp, but little elevated, irregular, unequal, and decussated by the lines of growth. The aperture is of an oblong, ovate form, and terminates in front in a long, narrow, and slightly curved canal; the outer lip is much

arched, and the sinus, which is wide and almost semicircular in shape, occupies the whole width of the margin.

Specimens occasionally occur in which the transverse lineation is nearly obliterated, and the whorls present a smooth, almost a polished, surface. The individuals figured by Mr. Sowerby were apparently in this condition; this smoothness, from which the specific name was taken, is, however, only an exceptional character.

The present species presents some analogy with *P. macilenta*; but the shell is narrower, the whorls more convex, more rounded on the shoulder, and more contracted in front; the canal is narrower, the outer lip more arched, and the sinus wider.

Size.—Axis, 1 inch and 3-12ths; diameter, rather more than 4-12ths of an inch.

Localities.—Barton, Muddiford (Highcliff). Mr. Sowerby also gives Highgate, but I do not know of any specimen from that locality. The species is, apparently, confined to the upper beds of the middle eocene deposits, and is not common.

No. 153. *PLEUROTOMA FUSIFORMIS*, Sowerby. Tab. XXVII, fig. 1 *a, b*.

PLEUROTOMA FUSIFORMIS, Sow. 1823. Min. Con., vol. iv, p. 119, t. 387, fig. 1.

— — — *Morris*. 1843. Cat. Brit. Foss., p. 157.

Non *PLEUROTOMA FUSIFORMIS*, Sow. 1831. Trans. Geol. Soc., 2d series, vol. iii, p. 418, t. 39, fig. 20.

P. testá elongatá, fusiformi, angustá, subturritá, longitudinaliter costatá, spiraliter fasciatá: spirá elevatá, acuminatá: anfractibús angulatis; ultimo anfractu antice sensim attenuato, in canali longo, lato, terminanti; marginibus posticis concentricè tenuiter lineatis, pauxillulum cavatis; costis rotundatis, ultimo anfractu evanescentibus; fasciis spiralibus numerosis, irregularibus, inæqualibus, lineis incrementi scabratís: aperturá lanceolatá; labro arcuato; sinu lato, sub-profundo, in margine collocato.

Shell elongated, narrow, fusiform, longitudinally ribbed, and spirally banded: the spire, which, in the larger specimen figured, consists of eight volutions exclusive of the pullus, is elevated, forming nearly two fifth parts of the whole length of the shell. The whorls are sharply angulated at the shoulders, giving a turreted appearance to the spire; the posterior margins are moderately wide, slightly depressed, a little thickened and crenulated round the suture, and ornamented with fine, concentric, raised lines, two or three of which, immediately behind the shoulder, are stronger than the rest, and granulated by the lines of growth of the sinus; the longitudinal ribs are rather numerous, rounded, and extend to the middle of the whorls, but become obsolete on the body-whorl of the adult shell; the spiral bands over the middle and front parts of the whorls are numerous, unequal, irregular, becoming more distant on the canal, where occasionally fine, thread-like lines rise between them; the bands are

much roughened by the lines of growth, giving a scabrous aspect to the shell: the body-whorl is attenuated very gradually in front, assuming a nearly conical shape, and terminates in a long, rather wide, and nearly straight canal. The aperture is lanceolate, the outer lip moderately arched, and the sinus, which is placed in the margin immediately behind the shoulder, is wide, moderately deep, and almost semicircular in form.

No foreign analogue of this well-marked species has as yet been noticed; and at present *P. fusiformis* appears to be confined to the older eocene strata in the neighbourhood of London, where it is exceedingly rare. Mr. Sowerby, it is true, has applied the name to a *Pleurotoma* from the so-called transition beds between the lower tertiaries and the upper cretaceous formation at Gosau, a notice of which is contained in a memoir 'On the Structure of the Eastern Alps,' by Prof. Sedgwick and Sir Roderick Murchison, published in the 'Geological Transactions' of 1831; but that shell is a short, wide, strongly costated shell, perfectly distinct in character from the Highgate shell, and the name *fusiformis* was used apparently in forgetfulness of its having been previously applied to the present species. The Gosau shell has been since distinguished by D'Orbigny as *P. sub-fusiformis*.

The specimens figured form part of Mr. Wetherell's collection.

Size.—If the larger specimen were perfect, the dimensions would be—axis, 1 inch and 9-12ths; diameter, 6-12ths of an inch. Those of the specimen figured in 'Mineral Conchology' appear to be—axis, 2 inches and 1-12th; diameter, rather more than 7-12ths of an inch.

Locality.—Highgate.

No. 154. *PLEUROTOMA SULCULOSA*. *F. E. Edwards*. Tab. XXVII, fig. 2 *a—c*.

P. testá elongatá, fusiformi, sub-turritá, concentrice sulcatá: anfractibus convexiusculis, angulatis, tuberculatis; marginibus posticis paucillulum cavatis, transversim interrupte lineatis, ad suturam incrassatis: aperturá oblongo-ovali, in canali longiusculo exeunti; labro valde arcuato; sinu lato, sub-trigono, in margine collocato.

Var. β. Testá tuberculis longitudinaliter compressis, ultimo anfractu evanescentibus, instructá.

Shell elongated, fusiform, transversely sulcated; spire formed of seven or eight volutions, moderately elevated, pointed: whorls rather convex, angulated at the shoulders, where they present a series of oblong, longitudinally compressed, and more or less oblique tubercles; the posterior margins slightly hollowed out, thickened on the sutural edge, round which runs an elevated, sharp line, granulated by the lines of growth of the sinus; the space between this line and the angle of the whorls is occu-

pied by three or four concentric lines, broken into oblong granulations, more or less widely separated by smooth spaces, formed at the successive stages of growth by the margins of the sinus; the angulated shoulders, and somewhat depressed margins of the whorls, give a turreted character to the spire. The tubercles are rather numerous, and prominent in all stages of growth; the transverse furrows deep, but not wide, and separated by rounded ridges, which are narrow near the shoulders, but become broader over the middle and front parts of the whorls, and on the canal. The body-whorl is suddenly contracted near the middle, and produced anteriorly into a wide, moderately long canal. The aperture is of a narrow, oblong, oval shape; the outer lip roundedly arched, almost semicircular in form; and the sinus, which is placed in the middle of the margin, is deep, rather wide, and sub-trigonal.

Specimens occur (*Var. β*, fig. 2 *b*) in which the tubercles are compressed, and a little prolonged, in the direction of the axis, imparting a sub-costellated appearance to the earlier whorls, and becoming obsolete as the shell approaches maturity.

This species presents a very close analogy with *P. fusiformis*, with which, in fact, it may be easily confounded. On comparing the two shells, however, it will be found that, in the present species, the shell is wider; the spire relatively more produced and tuberculated, not costated; the body-whorl more contracted, and less conical, in front; the canal wider and shorter; the outer lip more roundedly arched; and the sinus deeper, more trigonal, and placed nearer the middle of the margin. These distinctions, and the different ornamentation, which consists of deep conspicuous furrows instead of the rough spiral bands which characterise *P. fusiformis*, appear to me to justify the separation.

Size.—The dimensions of the largest specimen figured would be, if the shell were perfect—axis, 1 inch and 5-12ths; diameter, not quite half an inch.

Localities.—Highgate and Potters' Bar, at both of which localities it is rather scarce.

No. 155. *PLEUROTOMA ACUMINATA*, *Sowerby*. Tab. XXVII, fig. 3 *a—d*.

PLEUROTOMA ACUMINATA, *Sow.* 1816. *Min. Con.*, vol. ii, p. 105, t. 146, fig. 4.

— — — *D'Orb.* 1850. *Index Paléont.*, vol. ii, p. 359, No. 420.

— — — *Morris.* 1854. *Cat. Brit. Foss.*, 2d edit., p. 269.

Nec *PLEUROTOMA ACUMINATA*, *Nyst.* 1836. *Rech. coq. foss. de Hoesselt et Vliermael*, p. 32, No. 83.

nec — — — *De Kon.* 1837. *Desc. des coq. foss. de Basele Boom, &c.*, p. 24, No. 24.

nec — — — *Nyst.* 1843. *Bull. Soc. Géol. de France*, vol. xiv, p. 454, No. 27.

nec — — — *Ib.* 1843. *Descr. des coq., &c., de la Belgique*, p. 519, t. 42, fig. 1 *a, b*.

P. testá elongatá, angustá, turrítá, acuminatá, longitudinaliter costatá, concentricè sulcatá: anfractibus convexiusculis; marginibus posticis angustis, concavis, transversim granuloso-lineatis, ad suturam plicatis; sulcis concentricis confertis, antice distantioribus; spatiis sulcos separantibus lineis incrementi granulatis: aperturá oblongo-ovali, in canali lato, longiusculo exeunti; labro arcuato; sinu fere semicirculari, in margine collocato.

Var. α.—Testá latiori, breviori.

Var. β.—Testá levigatá; sulcis transversis semi-obliteratis.

Shell elongated, narrow, turreted, pointed, longitudinally ribbed and concentrically furrowed; the spire, formed of eight or nine volutions, much produced, equalling in length three fifths of the whole shell. The whorls are slightly convex; the posterior margins narrow, channeled, ornamented with several concentric raised lines, a little thickened at the suture, and plicated by the lines of growth of the sinus, which, in some specimens, are prominent over the whole margin, granulating the concentric lines; the last whorl is rather suddenly contracted in front, and terminates in a wide but not very long canal. The furrows in front of the shoulder are close-set, regular and equal, but, where the whorl begins to contract, they become more distant and irregular: the surface of the intervening spaces is granulated by longitudinal ridges formed by the elevated lines of growth; the longitudinal ribs are rather numerous, narrow, and extend to the middle of the whorls. The aperture is of a narrow, oblong-oval form; the outer lip but slightly arched, and the sinus, which is wide and almost semicircular in shape, is placed a little in front of the middle part of the margin. Specimens occasionally occur (*Var. α*, fig. 3 *b, c*) in which the shell is wider and shorter, and the spire is relatively not so much produced; and others, again (*Var. β*, fig. 3 *d*), in which the ribs disappear as the shell is enlarged, the transverse furrows are shallower and more closely set, and the lines of growth less prominent, giving to the surface a levigated appearance, as if it had been rubbed smooth.

MM. Nyst and De Koninck have severally described certain shells from Basele, Boom, and Kleyn-Spauwen, which they have referred, erroneously in my opinion, to the present species. In the general character of the ornamentation these shells apparently agree with the English shells; but with them, judging from the figure given by Nyst, the spire is relatively longer, the whorls more convex, the posterior margins less depressed, giving a more conical and less turreted form to the spire; the body-whorl more suddenly contracted, and the columella more arched: the characters, however, which most clearly distinguish the Belgian shells are the form and position of the sinus, which is wide and very shallow, and is placed on the shoulder, and not, as in the present species, in the margin of the whorls.

Size.—Axis, 1 inch and 3-12ths diameter, 4-12ths of an inch.

Localities.—Highgate, Hornsey, Potters' Bar, and Clarendon Hill, at which last locality both varieties occur.

The specimens represented by figs. 3 *a* and 3, form part of Mr. Wetherell's collection.

No. 156. *PLEUROTOMA PYRULATA*, *Deshayes*. Tab. XXVII, fig. 7 *a*, *b*.

PLEUROTOMA PYRULATA, *Desh.* 1824–37. *Descr. des coq. foss., &c.*, vol. ii, p. 449, t. 66, figs. 1–3.

P. testá elongatá, angustá, piruliformi, spiraliter lineatá: spirá mediocriter elevatá, sub-conicá; anfractibus angulatis, in medio convexiusculis, antice sensim attenuatis; marginibus posticis declivis, vix cavatis, concentrice tenuissime lineatis; ultimo anfractú in canali præ-longo terminanti; lineis spiralibus acutis, irregularibus, inæqualibus, lineis incrementi fortiter decussatis: aperturá elongato-ovali; labro parum arcuato; sinu latiusculo, profundo, in margine collocato.

Shell elongated, narrow, concentrically lined: the spire, formed of eight or nine volutions, is pointed and moderately elevated, not equalling in length a third part of the whole shell; the whorls are convex at the middle, bluntly angulated at the shoulders; the posterior margins but slightly depressed, giving a nearly conical form to the spire; slightly thickened at the edge, where they present two strong, prominent, raised lines, which run round the suture, and form a border to the whorls; the space between the suture and the shoulders is slightly channeled, and covered with several very slender, unequal, raised lines; the body-whorl diminishes gradually towards the base, and terminates in a very long and nearly straight canal. The gradual tapering of the whorls, joined to the rather short, conical spire, gives to the shell somewhat of the form of a long, narrow pear, from which appearance the specific name is taken. The spiral lines over the middle and front parts of the whorls are numerous, irregular, and unequal, slender thread-like lines alternating with thicker and more prominent lines; all are beautifully and regularly decussated by the strongly marked lines of growth. The aperture is of a long, narrow, oval form; the outer lip slightly expanded towards the middle; and the sinus, which is placed in the middle of the margin is deep and not very wide.

The French shells, in their typical form, are narrow, with a rather short spire; but, apparently, specimens from different localities present considerable variations, not only in the relative height of the spire and width of the shell, but also in the striation. The specimens from Compiègne, for instance, as M. Deshayes has recorded, have the spire more produced, the angle of the whorls more prominent, and the con-

centric lines more numerous; and in some specimens from Cuise-Lamotte, in my cabinet, the spire is also much elevated, the shell relatively narrower, and the concentric lines close-set, slender, and regular. In the English specimens the relative height of the spire and the character of the concentric lineation agree with those of the specimens from Compiègne; but the shell is wider, and the margins of the whorls are not so much depressed. These differences, however, attributable probably to local conditions only, do not suggest a doubt of the correctness of the identification.

Size.—Axis, rather more than 5-6ths of an inch (11 millim.); diameter, 3-12ths of an inch (rather more than 6 millim.).

Localities.—Clarendon Hill. French—Compiègne (fide *Desh.*); Cuise-Lamotte, Trosly-Breuil (fide *Graves*); Laon (fide *Mellev.*) MM. Deshayes and D'Orbigny also give Parnes; but M. Graves speaks with doubt of that locality.

No. 157. PLEUROTOMA TEREBRALIS, *Lamarch*, var. Tab. XXVII, figs. 10 *a—k*.

PLEUROTOMA TEREBRALIS, *Lamk.* 1804. Anm. du Musée, vol iii, p. 266, No. 20.

— — *Ib.* 1822. Hist. nat., &c., vol. vii, p. 101, No. 25.

— — *De Blainv.* 1826. Dict. des sci. nat., vol. xli, p. 391.

— — *Desh.* 1832. Encl. méth. (Vers.), vol. iii, p. 799, No. 21.

— — *Ib.* 1824-1837. Desc. des coq., &c., vol. ii, p. 455, t. 62, figs. 14—16.

Var. 1st. DITROPIS; fig. 10*a*. *P. testá parvulá, elongatá, fusiformi, angustá, turritá, lineis spiralibus elegantissime granulatis ornatá; spirá elevatá, acuminatá; anfractibus bicarinatis; marginibus posticis depressis, concavis, ad suturam granulatis, cæteris lævibus, vel tenuissime plicatis; cariná posticá acutá, denticulatá; cariná anticá fascioli-formi, denticulato-plicatá; lineis spiralibus plus minusve distantibus, inæqualibus; ultimo anfractu antice valde attenuato in canali longo exeunti; sinu lato, fere semicirculari, in margine collocato.*

Var. 2d. CONCINNA; fig. 10*i, k*. *Testá parvâ, bicarinatá, lineis spiralibus peræque granulatis, undique, etiam in marginibus anfractuum, ornatá; carinâ anticâ granulatá; lineis spiralibus numerosis.*

Var. 3d. GYRATA; fig. 10*b, d*. *Testá bicarinatá; carinis fascioli-formibus, crassis, oblique plicato-denticulatis; lineis spiralibus inæqualibus, granulosis.*

Var. 4th. PULCHERRIMA; fig. 10*e*. *Testá parvâ, bicarinatá; carinâ posticâ denticulatá; carinâ anticâ rotundatá, lævi; lineis spiralibus elevatis, rotundatis, simplicibus vel obsolete granulatis, suprâ canalem confertis, cæteris distantibus.*

Var. 5th. REVOLUTA; fig. 10*f*. *Testá bicarinatá; marginibus posticis anfractuum ad suturam lævissime crenulatis; carinâ posticâ acutá, obsolete plicato-denticulatá, superne revolutá; carinâ anticâ lineisque spiralibus granulatis.*

Var. 6th. PAGODA; fig. 10 h. Testá latiori, fasciolis et lineis spiralibus elevatis cinctá: anfractibus bicarinatis, ad suturam marginatis; carinis simplicibus, singulis unico sulco exaratis; cariná posticá superne revolutá; fasciolis numerosis, inæqualibus, lævibus.

The typical form of this elegant *Pleurotoma* is distinguished by the smooth concave margins of the whorls, by the remarkable regularity of the denticulation on the keel, resembling the teeth of a circular saw, and by the close-set rows of even, bead-like granulations, which cover the middle and front parts of the shell, slightly diminishing in size as they approach the anterior extremity of the canal. The shell, upon which Lamarck formed the species, was found at Parnes; and, apparently, the ornamentation which characterises it is confined in the French specimens to those from the "calcaire grossier." The species occurs, also, in the older eocene formations of that country; but the shells from them are generally of smaller dimensions, and present more or less strongly marked deviations from the typical ornamentation. In England the species has not as yet been found above the older eocene deposits; several forms, indeed, occur in them; one or two of which apparently agree with French varieties; but neither among them, nor, as I believe, among those from the "groupes glauconieux" of France, does the exact ornamentation of the typical *P. terebralis* of Lamarck occur.

In the first variety (*ditropis*), which corresponds with specimens in my cabinet from Cuisse-Lamotte, the shell is much smaller than that of the type, elongated, fusiform, narrow, turreted, and beautifully ornamented with concentric rows of regular bead-like granulations; the spire is pointed and much produced, being rather more than two fifths of the length of the whole shell. The whorls are somewhat convex, sharply angulated, and carinated at the shoulders; the posterior margins rather depressed, slightly channeled, and perfectly smooth, except round the suture, where they are bordered by a single row of small regular granulations; occasionally a specimen occurs in which the smoothness of the surface is broken by very fine curved plications formed by the successive margins of the sinus. The keel on the shoulder is sharp, prominent, and denticulated with great regularity: in front of this, just where the whorl begins to contract, is a thick concentric band, rather obliquely plicated, and so prominent as to present the appearance of a second keel on the whorl; the ends of the plications project beyond the edges of the band, giving to it a denticulated appearance. The concentric rows are unequal, irregular, and more or less distant in different specimens, but closer and more regular towards the anterior extremity. The last whorl is much attenuated in front, and terminates in a moderately long canal: the sinus is rounded, deep, and wide, occupying almost the entire width of the margin.

In the next variety (*concinna*) the shell is somewhat larger than that of the preceding variety, but yet smaller than that of the type; the front keel is narrower and less prominent than in the variety *ditropis*, and is evenly granulated; the concentric rows

of granulations are more numerous, and the margins of the whorls present, in addition to the sutural row of beads, three very slender concentric lines granulated by the lines of growth of the sinus. It has been before stated that one of the more prominent characters of the true *P. terebralis* is taken from the perfectly smooth concave margins of the whorls; and the granulated margins in the present case would apparently indicate a distinct species; but the occasional occurrence of a plicated margin in the last variety prepares the way for the present form; and as this agrees in all the more important characters with the variety *ditropis*, I have regarded it as merely another variety of *P. terebralis*.

The shell in the variety *gyrata* (fig. 10 *b—d*) is smaller than that of the type, and doubly keeled; but both keels are thick, band-like, and strongly and obliquely plicated, and have a denticulated appearance from the plications being continued over the edges of the bands; the plications, following the curve of the line of growth, are less oblique on the anterior keel than those on the posterior keel. A single slender raised line, finely granulated, traverses the space between the keels; the front part of the whorl is ornamented with several concentric raised lines, granulated with great regularity; of these, the one next to the anterior keel, in some specimens (as in fig. 10 *b*), and that next but one, in others (as in figs. 10 *c* and *d*), is the thickest and most prominent; the others slightly diminish in size as they approach the anterior extremity of the canal.

The next variety, *pulcherrima* (fig. 10 *e* and *g*),* appears to correspond with the variety *a* from Compiègne, noticed by M. Deshayes. In this variety the shell is small and doubly-keeled; the posterior or shoulder-keel denticulated, the anterior keel rounded and obscurely plicated, almost smooth; the front part of the whorls is ornamented with several distant, thickish, concentric lines, which also are smooth and simple, or but very feebly granulated; the whorls are bordered round the suture by a thickish raised line, obscurely granulated or plicated; the margins and the spaces between the keels and between the concentric lines are perfectly smooth.

The variety *revoluta* (fig. 10 *f*) is a modification of the variety *pulcherrima*; in it the sutural edges of the whorls are very faintly crenulated; the shoulder-keel is sharp, obscurely plicated and denticulated, and the edge is bent upwards: the anterior keel is round and feebly plicated, and the concentric lines are slender and finely granulated.

In the last variety to be noticed, the variety *Pagoda* (fig. 10 *h*), the granulation and denticulation, which in the typical form and the preceding varieties form more or less prominent characters, are wanting; and a new mode of ornamentation prevails. In this variety the shell, which is relatively wider, is doubly-keeled, and ornamented with simple spiral bands; the margins of the whorls are concave, and

* I have adopted for the shells forming this variety, the name by which they have been distinguished as a species in Mr. Wetherell's cabinet.

quite smooth, except where two slender, faintly crenulated, raised lines form a border round the suture. The keels are band-like and simple; the surface of each is traversed by a shallow but conspicuous furrow; the edge of the shoulder-keel is sharp, smooth, and bent upwards like that of the keel which characterises the preceding variety. The space between the two keels and the surface of the front part of the whorls is ornamented with numerous narrow, unequal, round-edged bands, between some of which a slender line occasionally appears; these bands are smooth, or but slightly roughened by the lines of growth.

A form intermediate between and connecting the last two varieties occurs, in which the sharp, smooth-edged, and furrowed shoulder-keel of the variety *Pagoda* is associated with an obscurely plicated anterior keel, and faintly granulated spiral lines.

Although the shell for which the variety *Pagoda* is proposed, differs so much in the ornamentation from the typical form, I do not regard it as specifically distinct. In the several varieties described, the characteristic ornaments of the species have been modified, and have become gradually less prominent, until at last, in the variety *revoluta*, they are almost obliterated; and the intermediate form, before noticed, connects that variety with the one in question, which, in fact, merely presents in strength a character of ornament which has already appeared in other varieties.

All the varieties are rare except the varieties *gyrata* and *Pagoda*, which appear to be more abundant.

Size.—Of the var. *ditropis*—axis, 5-12ths of an inch; diameter, 2-12ths of an inch: of the var. *concinna* and *pulcherrima*—axis, 7-12ths of an inch; diameter, rather more than 3-12ths of an inch: of the var. *gyrata*—axis, 1 inch, nearly; diameter, rather more than 5-12ths of an inch: and of the var. *Pagoda*, if the shell were perfect—axis, 1 inch and 2-12ths, nearly; diameter, 5-12ths of an inch.

Localities.—For the var. *ditropis*—Highgate, Potters' Bar, Hornsey, Hampstead; for the var. *concinna*—Highgate, Potters' Bar, Hornsey, Finchley; for the var. *gyrata*—Hornsey, Southampton, Shenfield; for the var. *pulcherrima*—Highgate and Clarendon Hill; and for the var. *revoluta* and *Pagoda*—Clarendon Hill. *French*—Parnes, Grignon, Beyne, Mouchy-le-Châtel, Compiègne (fide *Desh.*), Chaumont, Amblainville, Cuisse-Lamotte, Pont-Sainte-Maxence (fide *Graves*).

The specimens, fig. 10 *b* and *k*, are from Mr. Wetherell's cabinet.

No. 158. *PLEUROTOMA MICRODONTA*, *F. E. Edwards*. Tab. XXVII, fig. 4.

P. testá elongatá, fusiformi, tuberculatá, spiraliter exilissime lineatá: spirá elevatá, b-conicá: anfractibus angulatis, unicá serie tuberculorum denti-formium munitis; marginibus posticis latis, pauxillum cavatis, ad suturam cingulo triplici, distanter plicato, cinctis:

ultimo anfractu antice repentissime coarctato, in canali angusto, longiusculo, terminanti; lineis spiralibus confertis, inæqualibus, nonnullis eminentioribus, denticulatis: aperturá oblongo-ovali; labro valde arcuato, intus plicato; sinu lato, sub-trigono, in margine collocato.

Shell elongated, fusiform, tuberculated, and ornamented with very fine, concentric, raised lines; spire nearly conical and much produced, exceeding one half of the whole shell in length; whorls convex, sharply angulated at the shoulders, where they present a single row of small, rather close-set, tooth-shaped tubercles; the posterior margins wide, frequently extending almost to the angle of the preceding whorl, slightly channeled, and bordered round the suture by three sharp, elevated lines, crossed by distant, oblique plications, corresponding with the tubercles on the shoulders of the whorls; the space between the suture and the shoulder is covered with very fine and nearly equal concentric lines. The spiral lines over the middle and front parts of the lines are numerous, very slender, but unequal; every fourth or fifth line being rather thicker and more prominent than the rest, and denticulated; the intermediate lines are simple, nearly equal, and so fine as to be barely perceptible by the naked eye. The body-whorl is suddenly much contracted in front, and terminates in a narrow, but not very long canal: the aperture is of an oblong oval form; the outer lip much arched and plicated within, and the sinus, which is wide and sub-trigonal in shape, is placed a little in front of the middle part of the margin.

The present species presents some resemblance to *P. cymæa*, but is easily distinguishable by the more elevated spire, the more numerous and smaller tubercles, the character of the transverse ornamentation, and the shorter canal.

Size.—Axis, 1 inch and 2-12ths; diameter, 5-12ths of an inch, nearly.

Localities.—Highcliff, where it is very abundant, and Bracklesham Bay.

Section I—Shells fusiform.

- A. *Sinus in the posterior margin of the whorl.* } continued.
 *b. Canal short or indistinct.**

No. 159. *PLEUROTOMA ATTENUATA*, Sowerby. Plate XXVII, fig. 6 *a—c*.

PLEUROTOMA ATTENUATA, Sow. 1816. Min. Con., vol. ii, p. 103, t. 146, fig. 1.

— — *Ib.* 1850. Dixon's Geol., &c., of Sussex, p. 102, t. 6, figs. 11, 14.

— — *Morris.* 1854. Cat. Brit. Foss., 2d edit., p. 269.

* The sub-divisions dependent on the length of the canal are, it is unnecessary to say, merely artificial, and towards the extremes of the two, species occur which may be referred, apparently with equal propriety to either sub-division: in shells with a short canal, however, the anterior notch is generally wider and deeper, and consequently the crest on the columella will be more prominent.

Nec PLEUROMOMA ATTENUATA, *Desh.* 1824-37. *Descr. des coq. foss., &c.*, vol. ii, p. 483, t. 68, figs. 6, 8.

nec — — — *Dujar.* 1837. *Mém. Soc. Géol. de France*, vol. ii, p. 291, t. 20, fig. 22.

P. testá elongato-fusiformi, turritá, costatá, undique spiraliter lineatá: spirá elevatá, acuminatá: anfractibus angulatis, unicá serie nodorum spiniformium, costas coronantium, armatis; marginibus posticis latis, declivis, concavis, ad suturam paucillum incrassatis, tenuiter crenulatis; ultimo anfractu antice sensim attenuato, in canali longiusculo, lato, terminanti; costis brevibus, sub-distantibus, rotundatis; lineis spiralibus numerosis, in marginibus tenuibus; cæteris inæqualibus: aperturá lanceolatá; labro arcuato; sinu lato, subtrigono, in margine collocato.

Shell elongated, fusiform, turreted, longitudinally ribbed, and ornamented with concentric raised lines: the spire, formed of eleven or twelve volutions exclusive of the pullus, is much elevated and pointed; the whorls, angulated at the shoulders, are gradually attenuated towards the base, assuming an almost conical form; the body-whorl terminates in a wide, moderately long canal, rather deeply notched at the anterior extremity; the posterior margins are wide, slightly bent towards the preceding whorls, channeled along the middle, thickened at the sutural edge, and bordered by two thickish, prominent, raised lines, granulated or feebly plicated by the lines of growth. The ribs are rather distant, short, oblique, rounded, and terminate at the shoulder in large, transversely compressed, spiniform tubercles, the bases of which are frequently prolonged backwards half-way across the posterior margin. The whole surface of the whorls is covered with close-set concentric raised lines, which are thread-like and nearly equal on the margins, but irregular and unequal over the middle and front parts of the whorls; one or two more or less slender lines intervening between thicker and more prominent lines: the whole surface is roughened by the lines of growth, which in the Bracklesham Bay specimens are very prominent, and give a coarse, rugged character to the shell. The aperture is of a long, narrow, lanceolate form; the outer lip moderately arched; and the sinus, which is wide, not very deep, and sub-trigonal in shape, is placed in the margin. The columella is nearly straight, and presents a large prominent crest or comb at the anterior extremity.

M. Deshayes (*loc. cit.*) has given the specific name *attenuata* to certain shells from the older eocene beds of France, quite distinct from the present species, to which, in point of priority, the name belongs; and Dujardin has fallen into the same error with regard to a *Pleurotoma* from Touraine. D'Orbigny, in his 'Prodrome,' has distinguished the French eocene shells by the name *sub-attenuata*, and the miocene shells by that of *pseudo-attenuata*.

Size.—Axis, 4 inches, nearly; diameter, 1 inch and 2-12ths.

Localities.—Although Mr. Sowerby (Dixon's 'Sussex,' p. 102) and Mr. Morris

both cite Barton as a locality for this well-marked species, I have not been fortunate enough to meet with any specimen of it from that locality; it is confined, I believe, to the lower beds of the middle eocene formations. It is found plentifully at Bracklesham Bay, of which locality it may be said to be one of the characteristic fossils: it also occurs at Stubbington and White-Cliff Bay, and in the synchronous beds at Bramshaw.

No. 160. *PLEUROTOMA CONICA*, *F. E. Edwards* Tab. XXVII, fig. 8.

P. testá elongatá, fusiformi, omnino concentrice sulcatá, unicá serie tuberculorum munitá; spirá conicá, elevatá, dimidium totius testæ in longitudine superanti: anfractibus convexiusculis, antice subito coarctatis, suturá conspicuá separatis; marginibus posticis latis, paucilulum declivis, cavatis; ultimo anfractu in canali longiusculo terminanti; tuberculis longitudinaliter compressis, obliquis, curvis: aperturá oblongo-ovali; labro arcuato; sinu lato, sub-trigono, in parte anticá marginis collocato.

Shell elongated, fusiform, concentrically furrowed, and bearing on the shoulders a single row of tubercles: the spire conical, rather thick, and much elevated, exceeding one half of the whole shell in length. The whorls are slightly convex at the shoulders, rather suddenly contracted in front, and separated from each other by a very conspicuous suture; the posterior margins are wide, very slightly depressed, rather deeply channeled along the middle, and a little thickened on the sutural edge. The tubercles, which are somewhat numerous, are longitudinally compressed, narrow, oblique, and curved; the concentric furrows are nearly regular, shallow, and separated by narrow, rounded ridges, of which, as they approach the beak, every alternate one becomes more prominent than the rest. The aperture is of an oblong-oval form, and terminates in front in a slightly produced, widish canal; the outer lip is moderately arched; and the sinus, which is placed in the very front part of the posterior margin, almost on the shoulder of the whorl, is wide and sub-trigonal in shape.

This species, characterised by its thick, elevated, conical spire, is apparently confined to the older eocene beds in the neighbourhood of London. I have not met with any specimen of it either from Clarendon Hill or from the synchronous formations in Hampshire.

Size.—Axis, 11-12ths of an inch; diameter, 4-12ths of an inch.

Locality.—Highgate.

No. 161. *PLEUROTOMA DESMIA*, *F. E. Edwards*. Tab. XXVII, fig. 5.

P. testá elongatá, fusiformi, tuberculatá, spiraliter fasciolatá et lineatá: spirá sub-conicá, valde productá: anfractibus convexis, sub-angulatis, longitudinaliter plicatis; marginibus posticis depressis, concavis, concentricè lineatis, ad suturam cingulo duplici, distanter plicato, cinctis; ultimo anfractu repente coarctato, incanali breviculo exeunti: fasciolis numerosis, antice simplicibus, cæteris inæqualibus, nonnullis majoribus, crasse granulatis, cum aliis minoribus simplicibus, alternantibus: aperturá ovali; labro valde arcuato, intus plicato; sinu lato, sub-trigono, in margine collocato.

Shell elongated, fusiform, tuberculated, and ornamented with concentric bands and raised lines; the spire rather thick, nearly conical and much elevated, almost equalling two thirds of the whole shell in length: the whorls short, convex, and obscurely angulated at the shoulders, where they present a double row of small, transverse tubercles; the posterior margins much depressed, hollowed out, and concentrically lined along the middle, and bordered round the suture by a double line, distantly and obliquely plicated by the lines of growth of the sinus, which are very prominent over the whole width of the margin; the last whorl is suddenly contracted in front, and terminates in a rather short and narrow canal, widely notched at the anterior extremity. The spiral bands over the middle and front parts of the whorls are divided with much regularity into rows of coarse, oblong granulations, placed nearly below each other in an oblique direction, following the curve of the outer lip, and giving an appearance of plication to the whorl: the rows of granulations, which are separated by thickish, raised lines, rounded on the surface, diminish in size towards the front part of the whorls, until, on reaching the canal, they barely exceed the intervening lines in size, and the granulations become nearly obliterated. The aperture is of an oval form; the outer lip much arched, projecting in front, and plicated within; and the sinus, which is placed rather towards the front of the margin, is wide, moderately deep, and sub-trigonal in form. The columella is slightly curved, and presents in front, at the anterior extremity, a conspicuous crest or comb.

The present species, in the young state, somewhat resembles *P. microdonta*, but the shell is narrower, the spire relatively longer, and the canal shorter; the regular granulations which characterise the concentric ornamentation also render it easily separable. It is apparently confined to the middle eocene formations of Barton, where it is not uncommon.

Size.—Axis, 1 inch and 8-12ths, nearly; diameter, half an inch.

TAB. XXIV.

Fig.

1. *Mitra parva*, No. 120, *p.* 183.
 - a.* Back view, natural size.
 - b.* Back view, magnified.
 - c.* Front view, ditto.
2. *Mitra parva* (var. *pumila*). No. 120, *p.* 183.
 - a.* Back view, natural size.
 - b.* Back view, magnified.
 - c.* Front view, ditto.
3. *Mitra labratula*. No. 119, *p.* 182.
 - a.* Back view.
 - b.* Front view.
4. *Mitra obesa*. No. 122, *p.* 185.
 - a.* Back view, natural size.
 - b.* Back view, magnified.
 - c.* Front view, natural size.
 - d.* Front view, magnified.
5. *Mitra volutiformis*. No. 123, *p.* 186.
 - a.* Back view, natural size.
 - b.* Back view, magnified.
 - c.* Front view, ditto.
6. *Mitra scabra*, No. 118, *p.* 181.
 - a.* Front view, shell of mid-growth.
 - b.* Front view, adult shell.
 - c.* Back view, ditto.
7. *Mitra porrecta*. No. 121, *p.* 185.
 - a.* Front view, natural size.
 - b.* Front view, magnified.
 - c.* Back view, ditto.
8. *Conus diadema*. No. 124, *p.* 190.
 - a.* Back view, shell of mid-growth.
 - b.* Back view, adult shell.
 - c.* Front view, ditto.
 - d.* Back view, ditto. (Var. *pyriformis*.)
9. *Conus scabriculus*. No. 129, *p.* 198.
 - a.* Front view.
 - b.* Back view.
 - c.* Side view.

TAB. XXIV (*continued*).

Fig.

10. *Conus lineatus*. No. 130, *p.* 199.

a. Front view, natural size.

b. Front view, magnified.

c. Front view, (specimen described as *C. corculum*, Sow.)

11. *Conus dormitor*. No. 131, *p.* 200.

a. Side view.

b. Front view.

c. Back view.

12. *Conus velatus*. No. 126, *p.* 193.

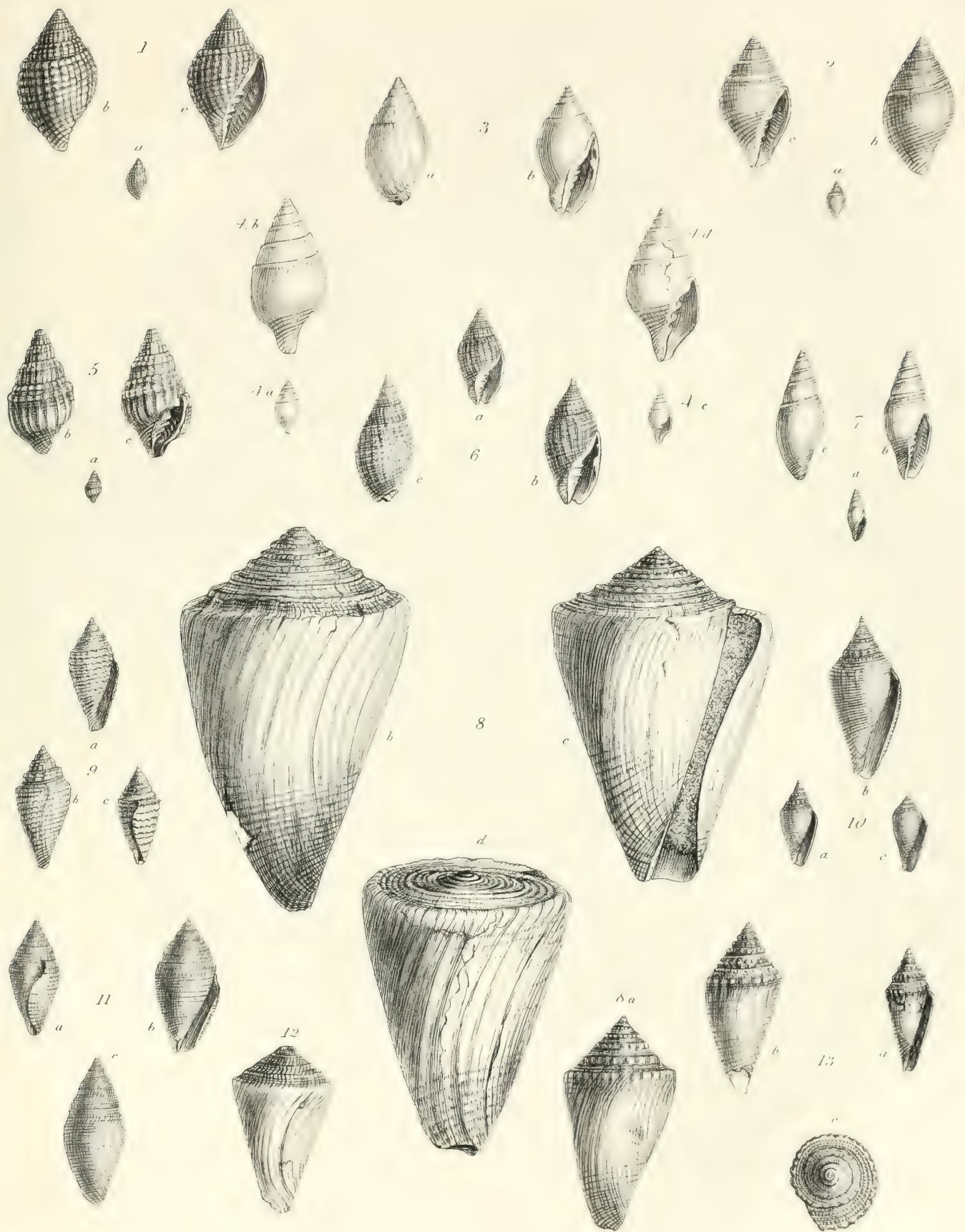
Back view.

13. *Conus concinnus*. No. 128, *p.* 196.

a. Front view, shell of mid-growth.

b. Back view, adult shell.

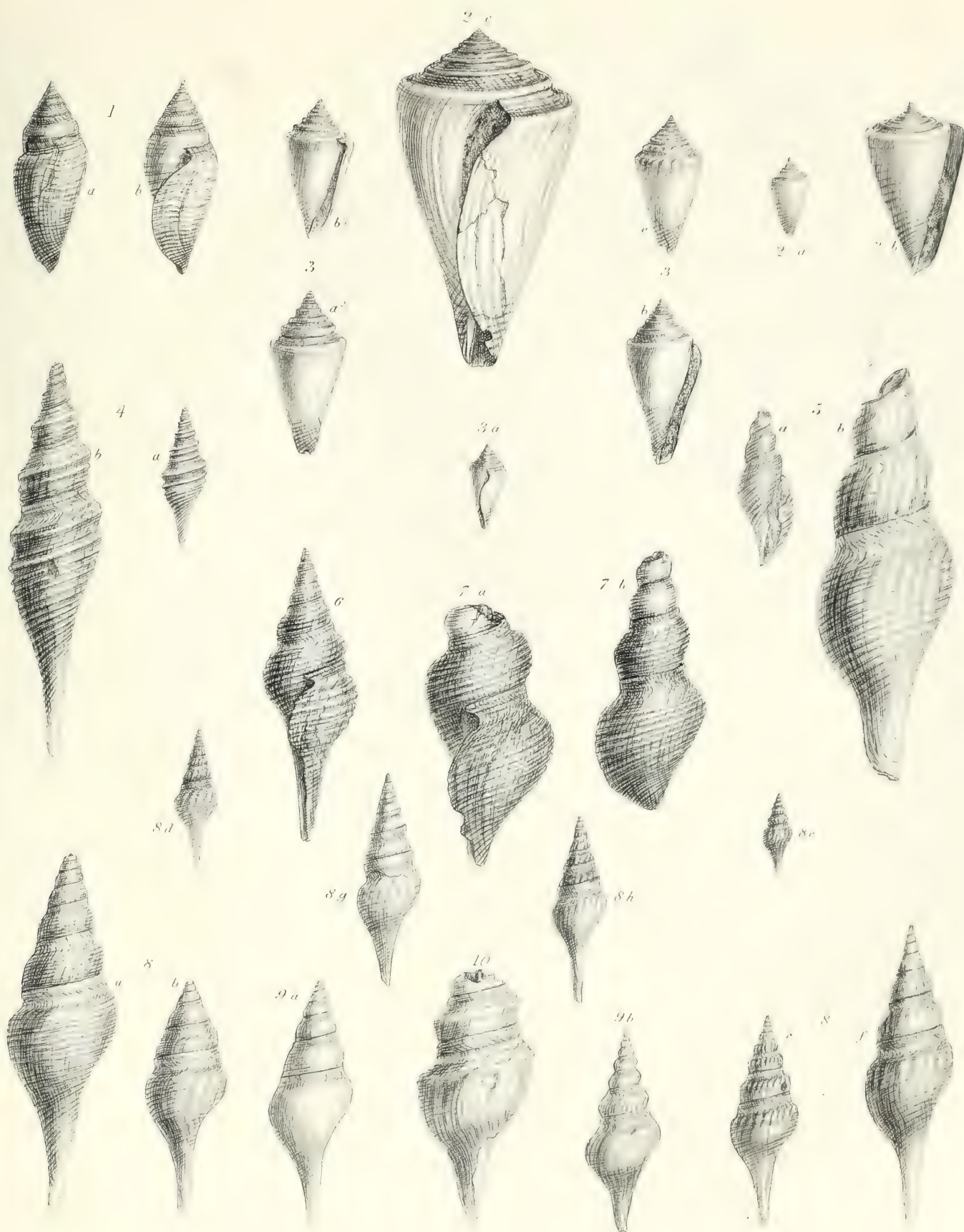
c. View from above, showing the posterior margins of the whorls forming the spire.



TAB. XXV.

Fig.

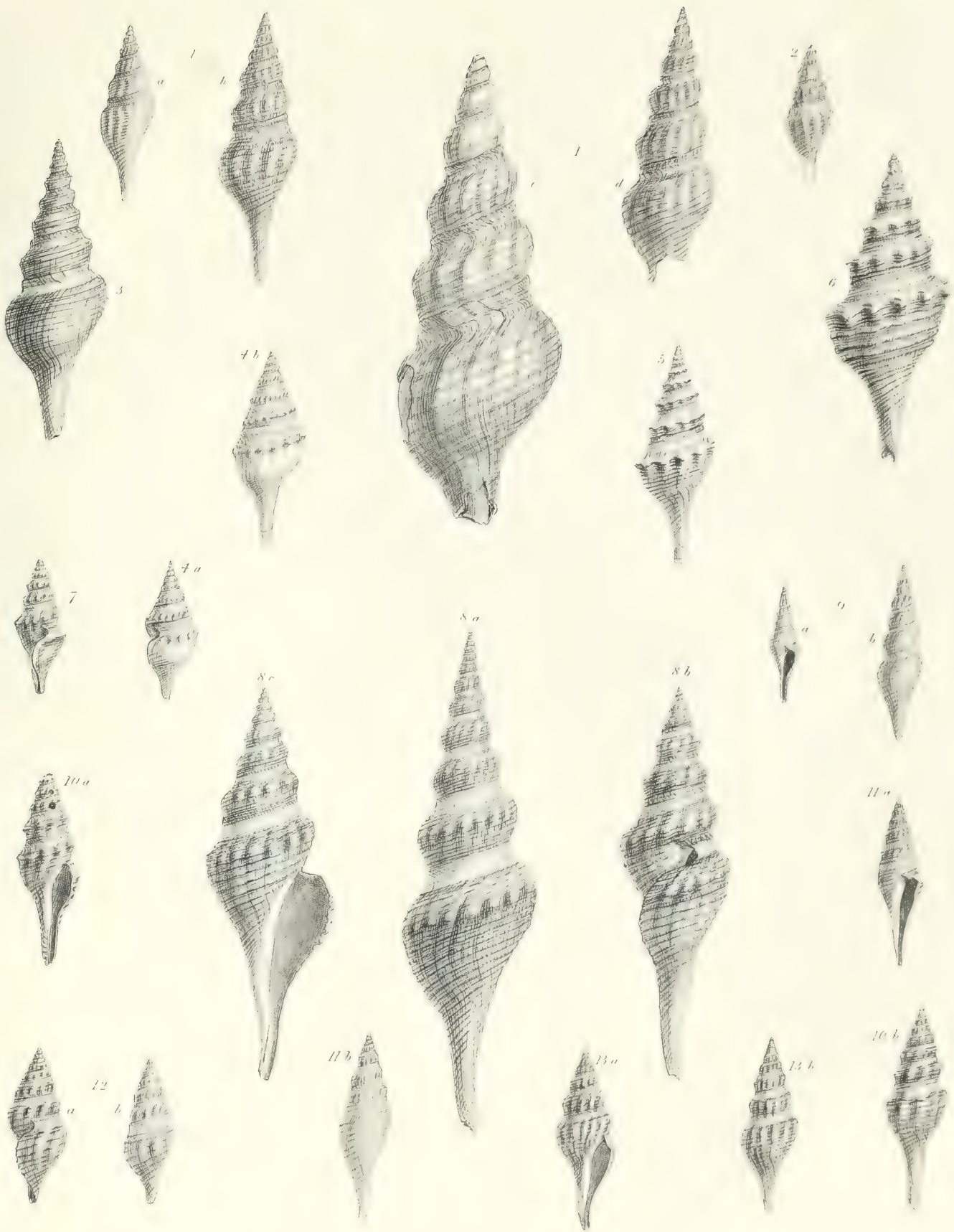
1. *Conus alatus*. No. 132, *p.* 202.
 - a.* Back view.
 - b.* Side view.
2. *Conus deperditus*. No. 125, *p.* 191.
 - a.* Back view, young shell.
 - b.* Front view, shell of mid-growth.
 - c.* Side view, adult shell.
3. *Conus Lamarekii*. No. 127, *p.* 194.
 - a.* Side view, young shell, from Bracklesham Bay.
 - a.** Back view, adult shell, from ditto.
 - b.* Front view, adult shell, from ditto.
 - b.** Front view, adult shell, from Bramshaw.
 - c.* Back view, adult shell, from ditto.
4. *Pleurotoma stena*. No. 133, *p.* 207.
 - a.* Back view, young shell, from Southampton.
 - b.* Back view, adult shell, from Highgate.
5. *Pleurotoma symmetrica*. No. 136, *p.* 209.
 - a.* Front view, young shell, from Highgate.
 - b.* Back view, adult shell, from Southampton.
6. *Pleurotoma inarata*. No. 134, *p.* 208.
 - Side view, adult shell.
7. *Pleurotoma helix*. No. 135, *p.* 209.
 - a.* Side view, adult shell.
 - b.* Side view, shell of mid-growth.
8. *Pleurotoma teretrium*. No. 137, *p.* 210.
 - a.* Back view, adult shell, from Highgate.
 - b.* Back view, adult shell, from ditto. (Var. *nanodis*.)
 - c.* Back view, young shell, from Southampton. (Var. *tuberculata*.)
 - d.* Back view, young shell, from ditto. ditto.
 - e.* Back view, shell of mid-growth, from ditto.
 - f.* Back view, adult shell, from Highgate. (Var. *crebrilinea*.)
 - g.* Back view, Highgate specimen. (Var. *latimarginata*.)
 - h.* Back view, ditto. ditto.
9. *Pleurotoma transversaria*. No. 141, *p.* 214.
 - a.* Back view, Brockenhurst specimen.
 - b.* Back view, Lyndhurst specimen. (Var. *cypha*.)
10. *Pleurotoma gonizæa*. No. 140, *p.* 213.
 - Back view.



TAB. XXVI.

Fig.

1. *Pleurotoma crassa*. No. 138, *p.* 212.
 - a.* Back view, young shell, from Southampton.
 - b.* Back view, shell of mid-growth, from Shenfield.
 - c.* Back view, ditto, from Shenfield.
 - d.* Back view, adult shell, from Nuneham.
2. *Pleurotoma cocciphora*. No. 143, *p.* 217.
 Back view, adult shell.
3. *Pleurotoma planetica*. No. 139, *p.* 212.
 Back view, shell of nearly full growth, from Bramshaw.
4. *Pleurotoma cymæa*. No. 142, *p.* 215.
 - a.* Back view, shell of mid-growth, from Brockenhurst.
 - b.* Back view, adult shell, from ditto.
5. *Pleurotoma dentata*. No. 146, *p.* 220.
 Back view.
6. *Pleurotoma Keelei*. No. 145, *p.* 219.
 Back view, nearly adult shell, from Shenfield.
7. *Pleurotoma textiliosa*. No. 147, *p.* 222.
 Side view, shell from Bracklesham Bay.
8. *Pleurotoma rostrata*. No. 144, *p.* 218.
 - a.* Side view, shell past mid-growth, from Barton.
 - b.* Back view, adult shell, from ditto.
 - c.* Front view, adult shell, from Highcliff. (Var. *antiqua*.)
9. *Pleurotoma lævigata*. No. 152, *p.* 227.
 - a.* Side view, shell of mid-growth, from Barton.
 - b.* Back view, adult shell, from ditto.
10. *Pleurotoma crassicosta*. No. 150, *p.* 225.
 - a.* Front view, adult shell.
 - b.* Back view, ditto.
11. *Pleurotoma lanceolata*. No. 151, *p.* 226.
 - a.* Front view, adult shell.
 - b.* Back view, ditto.
12. *Pleurotoma exorta*. No. 148, *p.* 223.
 - a.* Side view, adult shell.
 - b.* Back view, ditto.
13. *Pleurotoma macilenta*. No. 149, *p.* 224.
 - a.* Front view, adult shell, from Barton.
 - b.* Back view, adult shell, from ditto.

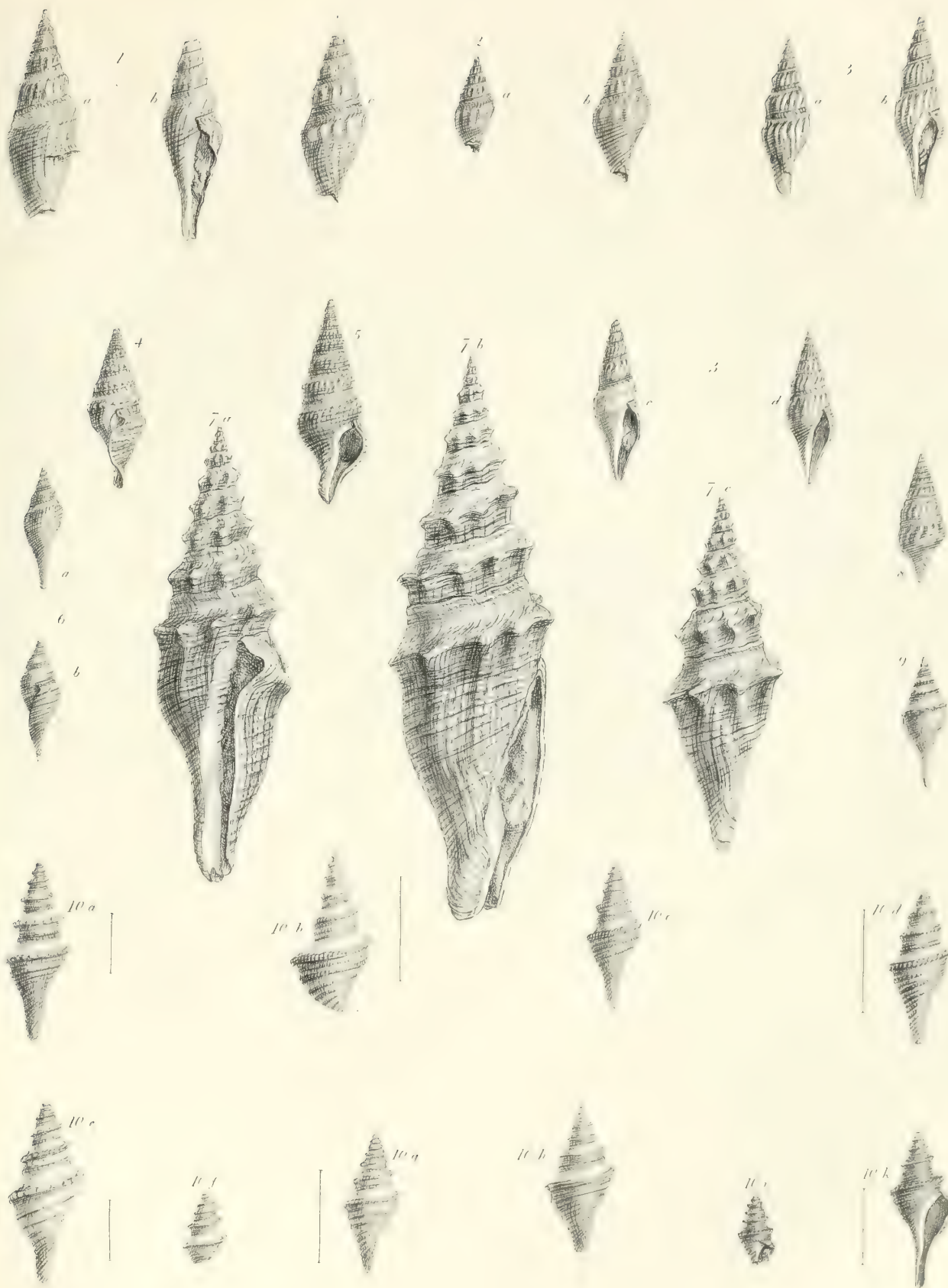


TAB. XXVII.

Fig.

1. *Pleurotoma fusiformis*. No. 153, *p.* 228.
 - a.* Back view.
 - b.* Front view.
2. *Pleurotoma sulculosa*. No. 154, *p.* 229.
 - a.* Back view, young shell, from Potters' Bar.
 - b.* Back view, shell of mid-growth, from ditto.
 - c.* Back view, adult shell, from Highgate.
3. *Pleurotoma acuminata*. No. 155, *p.* 230.
 - a.* Back view, adult shell, from Highgate.
 - b.* Front view, adult shell, from ditto.
 - c.* Front view, adult shell, from Hornsey, smooth variety.
 - d.* Front view, adult shell, from Clarendon Hill.
4. *Pleurotoma microdonta*. No. 158, *p.* 236.
 - Side view, adult shell, from Highcliff.
5. *Pleurotoma desmia*. No. 161, *p.* 240.
 - Front view, shell nearly adult.
6. *Pleurotoma pyrulata*. No. 156, *p.* 232.
 - a.* Back view, adult shell.
 - b.* Side view, ditto.
7. *Pleurotoma attenuata*. No. 159, *p.* 232.
 - a.* Side view, shell nearly adult.
 - b.* Side view, adult shell.
 - c.* Back view, shell of mid-growth.
8. *Pleurotoma conica*. No. 160, *p.* 239.
 - a.* Back view, adult shell.
9. *Pleurotoma cymæa*. No. 142, *p.* 215.
 - a.* Back view, young shell, from Colwell Bay.
10. *Pleurotoma terebralis*, *var.* No. 157. *p.* 233.
 - a.* Back view, shell magnified (*var. ditropis*), from Hampstead.
 - b.* Back view, shell magnified (*var. gyrata*), from Hornsey.
 - c.* Back view, shell natural size (*var. gyrata*), from Shenfield.
 - d.* Back view, shell magnified (*var. gyrata*), from Southampton.
 - e.* Back view, shell magnified (*var. pulcherrima*), from Highgate.
 - f.* Back view, shell natural size (*var. revoluta*), from Clarendon Hill.
 - g.* Back view, shell magnified (*var. pulcherrima*), from ditto.
 - h.* Back view, shell natural size (*var. Pagoda*), from ditto.
 - i.* Front view, shell natural size (*var. concinna*), from Potters' Bar.
 - k.* Front view, shell magnified (*var. concinna*), from Highgate.

NOTE.—The lines indicate the size of the specimens.



THE
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DESCRIPTION
OF THE
FOSSIL REMAINS OF MOLLUSCA
FOUND IN THE
CHALK OF ENGLAND.

BY
DANIEL SHARPE, PRES. GEOL. Soc., F.R. & G.S.

PART III.
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22. AMMONITES CENOMANENSIS, *D'Archiac*. Plate XVII, fig. 1.

AMMONITES CENOMANENSIS, *D'Archiac*. Mém. de la Soc. Géol. de France, 2me serie, vol. ii, pp. 62 and 78; Histoire des Prog. de la Géol., vol. iv, p. 347, note.

| | | | |
|---|-------------|--------------------|---|
| — | — | <i>D'Orbigny</i> . | Prodrome, vol. ii, p. 146. |
| — | WOOLLGARI, | <i>Id.</i> | Pal. Franç. Terr. Crét., vol. i, t. 108, figs. 1—3. |
| — | VIELBANCII? | <i>Id.</i> | Prodrome, vol. ii, p. 189. |

A. testá inflatá, transversim costato-tuberculatá; anfractibus quadratis; costis numerosis, rectis, ætate juniori ad dorsum quinque-tuberculatis, adultá simplicibus, continuis, bituberculatis; dorso latissimo, utroque latere tuberculato.

Shell inflated; whorls nearly square, crossed by about sixteen thick, straight, equal ribs; each rib starts from a large tubercle on the margin of the umbilicus, and bears another larger tubercle at the side of the back; the very young shell has not been seen; but at 4 inches diameter there are three tubercles on the dorsal part of each rib, between the two larger ones already mentioned; at the diameter of 8 or 9 inches these three tubercles are lost in a strong straight rib crossing the back, and forming right angles at its continuation with the lateral ribs; in the still older shell, of a foot in diameter, the ribs are less prominent, but the two tubercles at the sides of the back project $1\frac{1}{2}$ inch.

Largest diameter, 1 foot; width, 5 inches; height of aperture, 4 inches.

Common in the Grey Chalk of Kent, Surrey, and Sussex.

This Ammonite is so closely related to *A. Rhotomagensis*, that it may perhaps be only a variety of that species. The principal differences are in the ribs of the old shells, which in *A. Rhotomagensis* become less and less distinct, till they finally disappear; in *A. Cenomanensis* grow very prominent and square, and finally run into large projecting horns. It appears to have been distinguished by M. D'Archiac and M. D'Orbigny independently. The latter author first confounded it with *A. Woollgari*, of Mantell, with which it has little in common; but M. D'Archiac gave it the name which it must retain.

23. AMMONITES HIPPOCASTANUM, *Sowerby*. Plate XVII, figs. 2, 3, and 4.

AMMONITES HIPPOCASTANUM, *Sowerby*. Mineral Conchology, t. 114, fig. 2.

A. testá inflatá, costatá, spinoso-tuberculatá; anfractibus paucis, celeriter crescentibus, angulatis; costis 12—20 valde inæqualibus, tuberculatis; tuberculis 7 seriatis, inæqualibus; lateralibus interdum spinosis; dorso lato, 5 tuberculato; umbilico parvo, profundo; aperturá transversim rhomboideá.

Shell gibbose, with few broad and angular whorls, which increase rapidly in size, ornamented with transverse, unequal ribs, and seven rows of large unequal tubercles:

when young, the ribs are about twelve in number, nearly equal, each bearing seven tubercles; one large, close to the umbilicus; another, very large and conical, near the side of the back; and three on the back, which are smaller and compressed laterally: in the middle stage there is occasionally one small rib, bearing three or five tubercles, between the larger ones; and in the adult shell there are usually two such smaller tuberculated ribs between the principal ones, making about twenty ribs on the whorl, and the tubercles are very unequal in size: back very broad: umbilicus small and deep, exposing half the inner whorls: aperture transversely rhomboidal: septa with a very broad dorsal saddle, and two lateral lobes, of which the superior is bifid; the other has not been well seen.

Diameter, $2\frac{1}{2}$ inches; height of last whorl, $1\frac{1}{4}$ inch; width of aperture, $1\frac{1}{2}$ inch.

Tolerably common in the Chalk with silicious grains of Lyme Regis, Dorsetshire; and Chardstock, Somersetshire.

Many of the Continental authors have united this species with *A. Rhotomagensis*, probably without having seen the shell, which appears to be confined to one bed in the West of England. When very young the two shells are nearly alike; but *A. hippocastanum* may be known by its greater breadth of whorl, and large lateral spines. As it increases in size, it is distinguished by the rapid enlargement of its whorls, great breadth, and great inequality of its ribs and tubercles; while *A. Rhotomagensis* is, at all its stages, known by their uniformity. *A. Cunningtoni* has more affinity to *A. hippocastanum*; but not having seen the young state of that shell, I am unable to compare them thoroughly.

24. AMMONITES GOUPILIANUS, *D'Orbigny*. Plate XVII, figs. 5, 6.

AMMONITES GOUPILIANUS, *D'Orbigny*. Paléont. Franç. Terr. Crét., t. xciv, figs. 1—3.

A. testá discoideá, compressá, carinatá, transversim undato-costatá; costis depressis, numerosis inæqualibus bicurvatis: dorso obtuso, carinato, producto: anfractibus tribus, ad umbilicum declivibus, sub-carinatis, deinde sub-sulcatis, compressis: umbilico mediocri: aperturá elongato-ovatá: septorum lobis lateralibus 6, trifidis.

Shell discoidal, flattened on the sides, keeled; ornamented with numerous unequal, flexuous ribs, which, rising from the raised edge of the umbilicus, incline forward for two fifths of the width of the whorl, then bend slightly backwards, and again bend forward near the back, and are produced forward at the keel, marking the outline of the mouth of the shell at its successive stages of growth; a few of the ribs are stouter than the rest: umbilicus of moderate size, exposing about one fourth of the inner whorls, and bounded by nearly perpendicular walls: sides of the whorls depressed into a slight channel near the umbilicus: back obtuse, with a sharp keel, and projecting in a point over the oval mouth: septa with six trifid lateral lobes. In the youngest stage of growth seen, the larger ribs

rise into a tubercle near the umbilicus, and also on each side of the back : the old shell is nearly smooth, with faintly marked obsolete ribs.

Diameter, 3 inches ; height of the last whorl, $1\frac{1}{4}$ inch ; width of aperture, 1 inch.

From the Grey Chalk of Hamsey, near Lewes. The only specimen seen is in the British Museum, from the collection of Dr. Mantell. In France it has been found in the Grey Chalk near Saumur, and in the Upper Green Sand of Mondragon, near Orange. (*D'Orbigny*, loc. cit., p. 319.)

With some general resemblance to the variety *sub-plana* of *A. varians*, this species is distinguished from that and all the other known species of the Chalk by the depression of the sides of the whorl near the umbilicus, and the peculiar sigmoidal flexure of the ribs, in which characters it is related to *A. serpentinus*, Schloth., and several other species of the Lias and Lower Oolite.

Genotype of Schlotheimia pergasii Grun.
25. AMMONITES VELLEDEÆ, *Michelin*. Plate XVII, fig. 7 ; and Plate XIX, fig. 6.

AMMONITES VELLEDEÆ, *Michelin*. Magasin de Zoologie, t. xxxv.

— — *D'Orbigny*. Paléont. Franç. Terr. Crét., vol. i, t. lxxxii.

— — *Pictet and Roux*. Foss. des Grés Vert des env. de Genève, t. ii, fig. 1.

A. testá discoidéá, compressá, transversim subtilissimè costatá: anfractibus paucis, lateribus complanatis, dorso rotundatis: costis tenuibus, rectiusculis, numerosissimis, anfractum totum amplexentibus: umbilico minimo: aperturá elongato-ovatá, septorum lobis lateralibus trifidis.

Shell discoidal compressed, with few whorls, flattened on the sides, and rounded at the back ; crossed by numerous fine, equal, thread-like ribs, which embrace the whole whorl : umbilicus very small : * aperture elliptical : lateral lobes of the septa trifid.

Diameter, $1\frac{3}{4}$ inch ; height of the last whorl, 1 inch ; width of aperture, $\frac{1}{2}$ inch.

Found rarely in the Upper Chalk near Norwich, and in the Grey Chalk of Ventnor, Isle of Wight. In France and Savoy it is found in beds of the age of the Gault, attaining a diameter of 7 inches.

26. AMMONITES NAVICULARIS, *Mantell*. Plate XVIII, figs. 1—3, 5, 8.

AMMONITES NAVICULARIS, *Mantell*. Fossils of the South Downs, t. xxii, fig. 5.

— — *Sowerby*. Min. Conch., 555, fig. 2.

— — *D'Orbigny*. Prodrome, vol. ii, p. 146.

— GENTONI, *Brongniart*. Env. de Paris, t. vi, fig. 6.

— MANTELL, *D'Orbigny*. Paléont. Franç. Terr. Crét., t. 103.

— MILLETIANUS, *Dixon*. Geol. of Sussex, t. xxix, fig. 15.

* Owing to the specimen, pl. xvii, fig. 7, consisting of very soft Chalk, the umbilicus has been too much excavated, and is represented too large.

A. testá inflatá, costatá, interdum tuberculatá: anfractibus rotundatis: costis rectis, simplicibus, inæqualibus, ad dorsum continuis; junioribus tuberculatis; adultis angulatis, vel rotundatis: dorso rotundato, transversim costato, juniore trituberculato: umbilico parvo, profundo: aperturá semi-ellipticá: septorum lobis lateralibus, primo inæqualiter bifido, cæteris trifidis: variat angulis, tuberculisque costalibus plus, minusvé conspicuis.

Shell inflated, with few rounded or angular whorls, crossed by numerous strong, unequal ribs: back round, or angular at the sides: umbilicus small and deep, with half the inner whorls visible: ribs alternately longer and shorter; the longer ribs commence from a tubercle at the edge of the umbilicus, and sometimes bear a second tubercle on each side of the whorl; the shorter ribs rise on the side of the whorl, nearer to the umbilicus than to the back; all the ribs cross the back: in young shells there are three tubercles on the dorsal part of each rib, which give a slight angularity to the back and to the mouth; in older shells the rib is strong and prominent over the back, without any tubercles, and the back and the mouth are rounded: the superior lateral lobe of the septa is unequally bifid, the two others are trifid; only two lateral lobes are visible on the side of the whorl, the second auxiliary lateral lobe being on the slope of the umbilicus.

Diameter, $4\frac{1}{2}$ inches; height of last whorl, 2 inches; width of aperture, 2 inches.

Common in the Lower Chalk of the South of England.

This species was first described by Dr. Mantell from a very imperfect specimen, but was afterwards admirably figured in the 'Mineral Conchology;' nevertheless it was united to *A. Mantelli* by D'Orbigny, Bronn, and other Continental writers. They are, however, to be distinguished when young by the row of tubercles on the middle of the back of *A. navicularis*, and when old by the ribs of that species continuing elevated over the middle of the back; while in *A. Mantelli* there is a depression on the middle of the back at all periods of its growth. *A. Mantelli* is usually flatter, more angular, and more tuberculated than *A. navicularis*, but there are varieties which differ in these respects. The species are both found in the Lower Chalk; but I have seen no specimens of *A. navicularis* from the Upper Green Sand. In the 'Prodrome de Paléontologie,' M. D'Orbigny has again separated the two species.

A. Gentoni of DeFrance and Brongniart, is the young of *A. navicularis*, in the condition of my figure 5 c.

A. Milletianus of Dixon (not of D'Orbigny), is one of the many forms of this species, nearly the same as my figure 5.

27. AMMONITES MANTELLI, Sowerby. Plate XVIII, figs. 4—7.

AMMONITES MANTELLI, Sowerby. Min. Conch., t. lv.

- | | | |
|---|---|---|
| — | — | <i>Mantell.</i> Fossils of the South Downs, t. xxi, fig. 9; t. xxii, fig. 1. |
| — | — | <i>D'Orbigny.</i> Paléont. Franç. Terr. Crét., t. 104, figs. 1 and 2. (Not t. 103.) |
| — | — | <i>Id.</i> Prodrome, vol. ii, p. 146. |

A. testá discoideá, costatá, tuberculatá : anfractibus angulatis : costis simplicibus, rectiusculis, inæqualibus ; ad dorsum subcontinuis vel obsoletis, bituberculatis ; ad laterá 1, 2, vel 3 tuberculatis : dorso angulato, medio depresso : umbilico parviusculo : aperturá rhomboideá : septorum lobis lateralibus, primo inæqualiter bifido, cæteris trifidis.

Var. A. *Anfractibus tumidis : aperturá octangulari ; costis rectis, majoribus 8 tuberculatis, minoribus 6 tuberculatis ; tuberculis spinosis.*

Var. B. *Anfractibus compressis : aperturá angulato-ovali : costis subflexuosis : tuberculis dorsalibus conspicuis, cæteris obsoletis.*

Shell discoidal, with twenty to twenty-five tuberculated ribs, alternately long and short : whorls angular, depressed or tumid : ribs simple and usually straight, the longer ones commencing at a tubercle at the edge of the umbilicus, the shorter below the middle of the whorl, and all continuing across the back, with a depression in the middle of the back : tubercles varying from four to eight rows, of which the umbilical and dorsal rows are always present, the lateral rows being either well or faintly marked, or altogether absent : back depressed in the middle, with a row of tubercles on each side : umbilicus small and deep, allowing half the inner whorls to be seen : aperture rhomboidal : septa with three lateral lobes, the first unequally bifid, the others trifid.

Var. A. Whorls tumid : aperture octangular : ribs straight, with eight rows of large tubercles.

Var. B. Whorls flattened : aperture nearly oval : ribs slightly flexuous : dorsal tubercles distinct, the others nearly obsolete.

Diameter, 3 inches ; height of last whorl, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch ; width of aperture, $1\frac{1}{4}$ to $1\frac{3}{4}$ inch, according to the variety.

Found in the Lower Chalk and the Upper Green Sand of the South of England, and in beds of the same age throughout France.

The distinction between this species and *A. navicularis* will be found after the description of that species.

28. AMMONITES RENAUXIANUS, *D'Orbigny*. Plate XIX, fig. 2.

AMMONITES RENAUXIANUS, *D'Orbigny*. Paléont. Franç. Terr. Crét., t. xxvii.

A. testá discoideá, compressá, tuberculato-costatá : costis bi- vel tri-fidis, flexuosis, bituberculatis, ad dorsum sub-interruptis : dorso bituberculato ; juniore transversim sub-costato ; adulto sub-carinato : umbilico mediocri : aperturá truncato-ellipticá.

Shell discoidal, compressed, with few whorls, ribbed and tuberculated : ribs, about fifteen, bifid or trifid, each springing from a large tubercle near the edge of the umbilicus, and dividing into two or three flexuous branches, each of which bears another tubercle at the edge of the back : in young shells the ribs are faintly continued across the back ; but

in older specimens they end at the side of the back, and there is a slightly elevated ridge along the middle of the back, with a row of tubercles on each side; these dorsal tubercles are elongated transversely in the direction of the ribs: umbilicus shallow, leaving nearly half of the inner whorls visible: aperture nearly elliptical.

Diameter of the figured specimen from the Grey Chalk, $1\frac{3}{10}$ inch; height of the last whorl, $\frac{6}{10}$ inch; width of aperture, $\frac{4}{10}$ inch.

Rare in the Grey Chalk of Ventnor, Isle of Wight. It is also found in the Upper Green Sand, near Dorking, where it attains a diameter of 4 inches. In France it has been found in the lower part of the "Craie Chloritée."

Not having seen the young stage of any specimens of *A. Renauxianus* found in the Upper Green Sand, it is with some hesitation that I unite to that species these small shells found in the Lower Chalk. On a side view, they closely resemble *A. varians*, from which they differ in the form of the back, which never rises into a decided keel as in that species. The dorsal tubercles are also different, as they slope with the rib; while in *A. varians* they are compressed transversely to the rib, and parallel to the keel.

29. AMMONITES OCTO-SULCATUS, Sharpe. Plate XIX, fig. 3.

A. testâ discoideâ: anfractibus complanatis; dorso rotundatis, subtrilissimè costatis; sulcis 8 transversis, rectiusculis, impressis; costis numerosis, brevibus, dorsum amplexantibus: umbilico mediocri: aperturâ semi-ovatâ.

Shell discoidal; with few whorls, flattened on the sides, and rounded on the back, crossed by eight deep, very slightly flexuous furrows, between which are many short, delicate ribs bending forward, and well defined on the back, fading away in the middle of the sides of the whorl: umbilicus rather small, leaving a fourth of the inner whorls visible: aperture semi-oval.

Diameter, 1 inch; width of aperture, $\frac{3}{8}$ inch; height of last whorl, $\frac{4}{10}$ inch.

Found in the Grey Chalk of Ventnor, in the Isle of Wight, and in the Chalk with silicious grains, of Chardstock.

This species is nearly allied to *A. planulatus* and *A. Mayorianus*, of the Lower Chalk, and to *A. Guettardi* of the Neocomian of the South of France. It differs from the first two in having the constrictions more numerous, and the inner whorls more concealed; and from the last, in having the furrows straighter, and projecting more forward, a rather larger umbilicus, and flatter sides to the whorl. Unfortunately the septa have not been seen. *A. Belus*, D'Orbigny, has a similar form and ornaments, but the furrows incline backwards on crossing the back; while in all the other species just mentioned, they project forwards at the middle of the back.

30. AMMONITES ICENICUS, *Sharpe*. Plate XIX, fig. 4.

A. testá discoidéá, compressá, lævi, inornatá : anfractibus paucis : umbilico mediocri : dorso rotundato : aperturá ovatá : septorum lobis lateralibus, primo trifido, cæteris inæqualiter bifidis.

Shell discoidal, smooth ; with few whorls, flattened on the sides, and rounded on the back : umbilicus of middling size, allowing two fifths of the inner whorls to be seen ; aperture ovate : septa with four lateral lobes, the first trifid, the others unequally bifid.

Diameter, 2 inches ; height of last whorl, 1 inch ; width of aperture, $\frac{1}{2}$ inch.

Rare in the Upper Chalk near Norwich.

The *Ammonite* here described has few characters by which it can be distinguished, and may perhaps prove to be only a young shell. But the Upper Chalk contains so few Ammonites, that it is desirable to place on record all that are known. It belongs to the same group as *A. Lewesiensis*.

31. AMMONITES DEVERIANUS, *D'Orbigny*. Plate XIX, fig. 5.

AMMONITES DEVERIANUS, *D'Orbigny*. Paléont. Franç. Terr. Crét., t. 111, figs. 1 and 2.

A. testá inflatá, transversim tuberculato-costatá : anfractibus paucis, lateribus compressis, dorso rotundatis : costis inæqualibus, simplicibus vel bifurcatis, 9 tuberculatis : aperturá quadrato-rotundatá : umbilico magno.

Shell discoidal ; with few whorls, flattened on the sides, and rounded at the back, crossed by numerous tuberculated ribs, which are continued over the back : about half the ribs commence at a tubercle on the edge of the umbilicus, and are either simple or bifurcating ; between these there is often a shorter rib, commencing on the middle of the side of the whorl ; all are equal on the back : tubercles large and round, in nine rows ; viz., three on each side, and three on the back ; the dorsal rows containing about twice as many as the umbilical row : umbilicus very large, leaving nearly two thirds of the inner whorls visible : aperture nearly square, with the corners rounded off.

Diameter, 4 inches ; height of last whorl, $1\frac{3}{4}$ inch ; width of aperture, $1\frac{5}{8}$ inch.

From the Grey Chalk of Sussex. The only specimen seen is in the British Museum, from the collection of F. Dixon, Esq. It has been found in France in the " Craie Chloritée " of Uchaux.

This species is readily distinguished from all others by the number and position of the tubercles.

32. AMMONITES RUSTICUS, *Sowerby*. Plate XX, fig. 1.AMMONITES RUSTICUS, *Sowerby*. Min. Conch., t. 177.— — *D'Orbigny*. Paléont. Franç. Terr. Crét., t. 111, figs. 1 and 2.

A. testá discoideá, tuberculatá: anfractibus paucis, rotundatis: tuberculis 4 seriatis; 2 lateralibus distantibus, maximis, conicis; 2 dorsalibus minoribus, depressis, numerosis: umbilico maximo: dorso rotundato, medio plano.

Shell discoidal, tuberculated, with few rounded whorls: umbilicus very large, rounded at the sides, exposing three fourths of the inner whorls: tubercles in four rows, viz., one on each side of the whorl, a little above the middle, of ten or twelve very large, conical tubercles; and two on the back, of about twenty-four smaller, rounded, depressed tubercles: aperture nearly round.

Diameter, 6 inches; height of last whorl, $2\frac{1}{2}$ inches; width of aperture, 2 inches.

A very rare shell, found in the Lower Chalk near Lyme Regis, Dorsetshire.

33. AMMONITES RENEVIERI, *Sharpe*. Plate XX, fig. 2.

A. testá discoideá, compressá: umbilico parvo: aperturá truncato-hastatá: septorum lobis lateralibus tribus trifidis: ætate juniore, undato-costatá, tuberculatá; tuberculis 4 seriatis, ad umbilicum paucis, majoribus, dorsum versus elongatis, numerosis; dorso subcarinato; adultá omnino lævi, dorso rotundato.

Shell discoidal, with few flat whorls: umbilicus small, leaving half the inner whorls visible: mouth truncato-hastate: septa with three trifid lateral lobes: at the diameter of four inches, as in the specimen figured, the whorls have their sides ornamented with about ten ribs, each springing from a round tubercle at the edge of the umbilicus, reaching across half the width of the whorl, and then changing to a flattened undulation, which ends at the side of the back in a tubercle, elongated in the direction of the whorl; alternating with these ribs are similar flattened undulations, ending in similar tubercles: back faintly keeled in the middle: in older specimens the sides are quite smooth, and the back rounded.

Diameter, $6\frac{1}{2}$ inches; height of last whorl, $3\frac{1}{4}$ inches, width of aperture, 2 inches.

Found in the Grey Chalk near Bonchurch, Isle of Wight, and near Devizes.

This species has probably been overlooked from its resemblance to some of the forms of *A. varians*, from which it is to be distinguished by straighter and more simple ribbing, and by the septa, which have the dorsal saddle divided into three parts, in a manner which rarely occurs in this genus. I have named the species after M. E. Renevier, whose labours among the Cretaceous Rocks of Switzerland deserve our warmest thanks, and who has lately visited this country with the view of helping to bring into harmony the synonymy of the Cretaceous Fossils of England and the Continent.

34. AMMONITES SAXBII, *Sharpe*. Plate XX, fig. 3.

A. testá discoideá, compressá, tuberculato-costatá: anfractibus paucis, complanatis, angulatis: dorso plano, bi-tuberculato: costis rectis 8—10 majoribus tri-tuberculatis, 20 minoribus bi-tuberculatis: aperturá rhomboideá: septorum lobis lateralibus bifidis.

Shell discoidal, compressed; whorls few, flattened on the sides: back flat, with angular edges, and a row of tubercles on each side: ribs about thirty, straight, of which eight or ten rise from a tubercle on the edge of the umbilicus, and the others begin on the middle of the side of the whorl; all ending in a large tubercle at the side of the back, and also bearing a smaller tubercle before reaching the back; there being either two or three of the smaller ribs between every two longer ones: aperture rhomboidal: umbilicus small, bounded by steep sides, and allowing two thirds of the inner whorls to be seen: lateral lobes of the septa bifid.

Diameter, 1 inch; height of the last whorl, $\frac{1}{2}$ inch; width of the aperture, $\frac{3}{8}$ inch.

Rare in the Grey Chalk of Ventnor, Isle of Wight.

A pretty little shell, readily distinguished from all the varieties of *A. varians* by its straight ribs and want of keel. It is named after S. Saxby, jun., Esq., who has rendered me much assistance in collecting together the fossil species of the Chalk of the Isle of Wight.

35. AMMONITES VECTENSIS, *Sharpe*. Plate XX, fig. 4.

A. testá discoideá: anfractibus, lateribus compressis, dorso rotundatis, transversim costatis: costis inæqualibus, flexuosis, supra dorsum continuis: umbilico mediocri: aperturá ovali.

Shell discoidal, with few whorls, which are flattened on the sides, rounded at the back, and crossed by about twenty flexuous, slightly elevated ribs; the ribs commence at the edge of the umbilicus, and slope forward to the middle of the side of the whorl, where they bend backwards a little way, and then again slope forwards over the back; besides these there are about ten shorter ribs occasionally inserted between the former, which only begin on the middle of the side, and equally cross over the back: umbilicus of moderate size, leaving more than half the inner whorls exposed: aperture oval: septa not seen.

Diameter, $2\frac{1}{4}$ inch; height of last whorl, 1 inch; width of aperture, $\frac{5}{8}$ inch.

Only one imperfect specimen has been seen, which was found in the Chloritic Marl, near Ventnor, Isle of Wight.

This species is related to *A. consobrinus*, D'Orbigny, and *A. cinctus*, Sowerby, but is not in danger of being confounded with either. It is also related to *A. undatus*, Sowerby; but

I find it impossible to compare them properly, for the original specimen of *A. undatus* which Mr. J. de C. Sowerby has had the kindness to lend me, is so much crushed, that its real characters cannot be distinguished; and that name had better be omitted from our lists.

36. AMMONITES LEWESIENSIS, *Mantell*. Plate XXI, fig. 1.

AMMONITES LEWESIENSIS, *Mantell*. Fossils of the South Downs, t. 22, fig. 2.

— — *D'Orbigny*. Paléont. Franç. Ters. Crét., t. 102, figs. 1, 2? note t. 101.

A. testá subinflatá: anfractibus rotundatis, lateraliter sub-compressis, undato-costatis; dorso lævi rotundato: umbilico parvo: aperturá ovatá: septorium lobis lateralibus 4 inequaliter trifidis.

Shell inflated: whorls few, with their sides a little flattened, and crossed by about twelve broad, radiating undulations, or indistinct ribs, which commence at the edge of the umbilicus, and die out before reaching the rounded, plain back: umbilicus rather small, with steep sides, allowing above one third of the inner whorls to be seen: aperture oval; septa with four unequally trifid lateral lobes, and a very narrow dorsal lobe.

The young shell differs little from the adult; it has the same plain, round back, but the undulations are hardly visible till it has reached a diameter of 4 to 6 inches: in very old shells, of 2 feet in diameter, the outer whorl becomes quite smooth.

This is one of the largest species of Ammonite found in the Chalk, sometimes exceeding two feet in diameter: the dimensions of the specimen figured are—diameter, 16 inches; height of the last whorl, 6 inches; width of the opening, 5 inches.

Rather rare in the Grey Chalk near Lewes and Dover.

Three species have been published under the name of *A. Lewesiensis* by Mantell, Sowerby, and D'Orbigny. The description and figure given by the first are so imperfect as to have made me almost despair of ascertaining what it represented, until Mr. Woodward discovered Dr. Mantell's original specimen in the vaults of the British Museum. The specimen is very imperfect, a part of the back on the younger side of the whorl being worn off, and the whole being so much crushed as to reduce the size of the umbilicus considerably, and to render the whorls flatter, and the back less round, than in perfect specimens: nevertheless it is sufficient to enable us to recognise the species with certainty.

A. Lewesiensis, when full grown, much resembles *A. peramplus*; but it is flatter, and the undulations are continued all across the side of the whorl, instead of stopping in the middle of its side, as in *A. peramplus*. The young shells of the two species have no resemblance, *A. Lewesiensis* being nearly smooth, and the other ornamented with numerous ribs, which cross over the back. The form of the lateral lobes of the septa is nearly the same in the two species; but in *A. Lewesiensis* the dorsal lobe is very narrow, while

in *A. peramplus* the dorsal lobe is broad, and the superior lateral lobe thrown in consequence farther from the middle of the back.

The *A. Lewesiensis* of the Mineral Conchology (my *A. leptophyllus*) has flatter whorls, a narrower aperture, more distinct ribs, an impressed line along the middle of the back, and the lateral lobes of the septa branching into most complicated subdivisions, in strong contrast with those of the true *A. Lewesiensis*. Hitherto it has only been found in the Upper Chalk.

M. D'Orbigny's shell has no resemblance whatever to the *A. Lewesiensis* of Mantell, and very little to that of Sowerby. It is readily distinguished by a series of numerous short ribs, which, commencing outside the middle of the whorl, are continued towards the middle of the back, where they are suddenly interrupted by an impressed line: the septa are as minutely subdivided as in *A. leptophyllus*, but the lateral lobes are straight and regularly trifid. It is stated in the 'Paléont. Franç.,' that this species is found in France, in the Lower Chalk: here I have only received it from the North of Ireland, from a bed which I suspect to belong to the Upper Chalk. In the 'Prodrome de Paléontologie,' p. 212, M. D'Orbigny, has named this species *A. Gollevillensis*, having learned that it differs from the *A. Lewesiensis* of Sowerby, and he removes its habitat from the *Terrain Turonien*, or Grey Chalk, wherein he quoted it in the 'Paléontologie Française,' to the *Terrain Sénonien*, or White Chalk.

M. d'Archiac, in his 'Histoire du Progrès de la Géologie,' quotes *A. Lewesiensis* as peculiar to the Lower Chalk of France; but I do not know to which of the three species here mentioned he alludes.

37. AMMONITES WIESTII, Sharpe. Plate XXI, fig. 3.

A. testá discoideá, costatá: anfractibus paucis inflatis: costis 24—30 prominentibus, inæqualibus: dorso rotundato, costato: umbilico parviusculo, profundo: aperturá semi-ovatá.

Shell discoidal, with few inflated whorls, ornamented with twenty-four to thirty strong, rounded ribs of unequal length, of which ten rise near the edge of the umbilicus, and the rest near the middle of the side of the whorl, and all are continued across the broad, rounded back, where they incline a little backwards: umbilicus deep and rather small, allowing half of the inner whorls to be seen: opening semi-ovate: the lobes of the septa have not been seen.

Diameter, $2\frac{3}{4}$ inches; height of the last whorl, $1\frac{1}{4}$ inch; width of the opening, $1\frac{1}{8}$ inch.

Very rare in the Chalk with silicious grains, Chardstock, Somersetshire.

I have seen only one specimen of this elegant *Ammonite*, which I have named after its discoverer, J. Wiest, Esq., of Chardstock, from whom I have received great assistance in the preparation of this work.

38. AMMONITES LEPTOPHYLLUS, *Sharpe*. Plate XXI, fig. 2, and Plate XXII, fig. 1.AMMONITES LEWESIENSIS, *Sowerby*. Mineral Conchology, t. 358.— — *D'Orbigny*. Prodrome de Paléontologie, vol. ii, p. 189.

A. testá discoideá, compressá, undulato-costatá: anfractibus lateraliter costatis, dorso lævibus: costis numerosis, paulum elevatis: dorso rotundato lævi, lineá angusta impresso: umbilico parvo: aperturá elevato-ellipticá: septorum lobis lateralibus ramosissimis, ramis irregulariter alternantibus.

Shell discoidal, flattened at the sides, rounded at the back: sides of the whorls crossed by numerous radiating undulations, or low, broad ribs, which commence at the umbilicus, and die out before they reach the back: umbilicus small, bounded by steep sides, allowing more than half the inner whorls to be seen: back smooth and rounded, marked with a narrow, impressed line: opening high and narrow: lobes of the septa much subdivided; the superior lateral lobe very large, with numerous irregularly alternate branches, ending in long, pointed digits. In very old specimens the undulations are very faint, and gradually disappear.

This species reaches a diameter of more than $2\frac{1}{2}$ feet. The proportions of the specimen figured are—diameter, 12 inches; height of the last whorl, 5 inches; width of the aperture, 3 inches.

Found in the Upper Chalk of Brighton, Ramsgate, Greenhithe, &c.; but, from the softness of the chalk in which it occurs, it is very seldom met with in good preservation.

This is not the species originally named by Dr. Mantell *A. Lewesiensis*, nor is it the species published under that name by M. D'Orbigny in the 'Paléontologie Française,' which is now called *A. Gollevillensis*; but in his 'Prodrome de Paléontologie,' that author has so far corrected himself as to separate the last-named species from the one here described.

As there have thus been three species passing under the name of *A. Lewesiensis*, it is impossible to know what is meant when this name is cited in geological works; a comparison of the three species is given, after the description of *A. Lewesiensis*.

39. AMMONITES GOLLEVILLENSIS, *D'Orb.* Plate XVII, fig. 2.AMMONITES LEWESIENSIS, *D'Orbigny*. Paléont. Franç. Terr. Crét., t. 101.— — *Id.* Prodrome de Paléontologie, vol. ii, p. 212.

A. testá discoideá, compressá, costatá: anfractibus lateraliter lævibus, dorso costatis: costis brevibus, numerosis, æqualibus, ad dorsum interruptis: dorso rotundato, costato, lineá

angustá, costas interrumpente, impresso: umbilico parviusculo: aperturá ovatá: septum lobis lateralibus trifidis ramosissimis.

Shell discoidal, whorls smooth and flattened on the sides, and ribbed on each side of the rounded back; ribs short, numerous, and equal, commencing beyond the middle of the side of the whorl, and suddenly interrupted at the middle of the back by a narrow, impressed line: umbilicus rather small, allowing about one third of the inner whorls to be seen: aperture oval: septa very numerous, with minutely subdivided lobes; lateral lobes trifid, with regularly opposite branches.

Diameter, $1\frac{1}{2}$ inch; height of the last whorl, 2 inches; width of the aperture, $1\frac{1}{4}$ inch.

Rare in the hard Chalk of the county of Londonderry, which is supposed to be of the age of the Upper Chalk of England.

This species is closely related to *A. Oldhami*, from which it is distinguished by its short ribs, nearly confined to the back, and its smooth sides. In the 'Paléontologie Française,' M. D'Orbigny confounded this Ammonite with Sowerby's *A. Lewesiensis* (*A. leptophyllus*, Sharpe), and quoted it from the upper beds of the "Craie Chloritée," or on the level of our Grey Chalk. In his 'Prodrome' he separates it from that species, and considers the beds in which it is found as part of the Upper Chalk.

It is difficult to understand how two such different species could ever have been confounded, as the only character common to both is the impressed dorsal line. The lobes of the septa of both are much subdivided, with spiked terminal digits, but in *A. Gollevillensis* they are trifid, with opposite and extremely regular branches. In *A. leptophyllus* they bifurcate several times with very unequal alternating branches, and great irregularity.

40. AMMONITES CURVATUS, *Mantell*. Plate VII, figs. 8, 9; Plate XXIII, fig. 1.

AMMONITES CURVATUS, *Mantell*. Fossils of the South Downs, p. 118, t. 21, fig. 18.

— — Sowerby. Min. Conch., t. 579, fig. 2.

— FALCATUS? *Pictet* and *Roux*. Grès Verts des Env. de Genève, t. 5, fig. 5.

A. testá discoideá, sub-compressá, tuberculatá, plerumque costatá; anfractibus paucis sub-angulatis, lateribus depressis, tuberculatis; dorso canaliculato, utrinque bituberculato: costis bicurvatis variantibus; interdum paucis, latis, depressis; interdum ad umbilicum numerosis, dorsum versus paucis, latisque; sæpé omnino obsoletis: tuberculis utrinque tri-serialibus, ad umbilicum simplicibus, propè dorsum binis: umbilico parvo: aperturá rhomboideá: septorum lobis lateralibus tribus trifidis.

Shell discoidal, flattened on the sides and back, with very few nearly rhomboidal whorls; strongly tuberculated, and frequently ribbed: back with two rows of tubercles on

each side, and a hollow canal in the middle: ribs falcate, very variable in number and size, and, rising from tubercles on the edge of the umbilicus, they extend forward to the middle of the side of the whorl, then suddenly turn backward, and again curve forward to the dorsal tubercles; sometimes they are five in number, broad and depressed; in other specimens they are small and numerous on the inner half, and broad and few on the outer half of the whorl; frequently they are well marked on young shells, and gradually disappear with age; and in many specimens they are altogether wanting: three rows of tubercles on each side of the whorl, one at the edge of the umbilicus, and two near the edge of the back; the umbilical tubercles vary both in size and number; when there are no ribs, the tubercles are few in number, and very large; but they diminish in size, and increase in number, in proportion to the development of the ribs; the dorsal tubercles are usually large, but they vary in number from 15 to 30, being fewest and largest where there are no ribs: umbilicus small and deep, allowing about one third of the inner whorls to be seen: aperture rhomboidal: septa with three trifid lateral lobes on each side.

Diameter, $1\frac{1}{2}$ inch; height of last whorl, $\frac{5}{8}$ inch; width of aperture, $\frac{1}{2}$ to $\frac{3}{4}$ inch.

Found abundantly in the Chloritic Marl of the Isle of Wight; the Chalk with silicious grains at Chardstock, Somersetshire; and the junction bed of the Chalk and Upper Green Sand, near Warminster.

In the first part of this Memoir, I followed M. D'Orbigny and most other modern palæontologists in uniting together the *Ammonites falcatus* and *curvatus* of Mantell and Sowerby; but, as better materials have appeared, I have been obliged to separate them again. Both are most variable species, and there are varieties which can only be distinguished with difficulty. The only invariable distinction which I have found between them is in the termination of the superior lateral lobe, which is trifid in *A. curvatus* and bifid in *A. falcatus*; see Pl. XXIII, figs. 1 c and 2. In comparing the external forms, it will be found that the more tuberculated varieties all belong to *A. curvatus*, the flatter, ribbed varieties to *A. falcatus*; but there are intermediate forms combining falcate ribs with dorsal tubercles, which can hardly be distinguished without the aid of the lateral lobe.

41. AMMONITES SALTERI, Sharpe. Plate XXIII, figs. 3 and 5.

A. testá discoideá, costatá, tuberculatá: costis ternatis flexuosis, bi-tuberculatis, ad dorsum interruptis: dorso utrinque tuberculato, tuberculis alternantibus: umbilico parvo: aperturá oblongá: septorum lobo dorsali longissimo.

Shell discoidal, with few whorls, ornamented with ribs and tubercles on their sides: back plain, and slightly elevated in the middle, with a row of tubercles on each side; these

are not opposite to one another, but alternate: ribs flexuous, rising in threes from twelve large tubercles which surround the umbilicus, forming an irregular zigzag pattern on the side of the whorl, and ending at twenty-four rather smaller tubercles on the side of the back: two rows of tubercles on each side of the shell: umbilicus small, allowing about one third of the inner whorls to be seen: aperture oblong: septa with the dorsal lobe considerably longer than the trifold superior lateral lobe.

Found by Mr. Wiest, in the Chalk with silicious grains, at Chardstock, Somersetshire.

42. AMMONITES RAMSAYANUS, *Sharpe*. Plate XXIII, fig. 4a—c.

A. testá discoideá, costatá, tuberculatá: anfractibus paucis, sub-compressis: costis continuis, bi-tuberculatis, ad dorsum bifurcantibus: dorso lato, rotundato, costato, utrinque tuberculato: umbilico parvo: aperturá oblongá.

Shell discoidal, with few, slightly flattened whorls, and a broad, rounded back: the whorls are ornamented on the sides by twenty ribs, each of which rise from a small tubercle at the edge of the umbilicus, and bear another larger tubercle near the back; at the latter tubercle each rib divides into two smaller ribs, which continue across the back, and unite again at the corresponding tubercle on the other side of the back: umbilicus small, allowing nearly half of the inner whorls to be seen: aperture oblong: the septa have not been seen.

Diameter, $1\frac{1}{2}$ inch; height of the last whorl, $\frac{5}{8}$ inch; width of the aperture, $\frac{1}{2}$ inch.

Very rare in the Chalk with silicious grains, at Chardstock, Somersetshire.

The only specimen which has been seen of this species is deformed, owing, without doubt, to an accident met with when very young. In consequence of this malformation, the two sides have very little resemblance to each other; and the specific character given above may prove incorrect when more perfect specimens are met with.

A. Ramsayanus belongs to the group of the *Coronarii*, which, for the most part, belong to the lower and middle divisions of the Oolitic series: its nearest congeners are perhaps *A. Humphriesianus* and *A. Brackenridgii*. It is the second species of that group which has been found in the Chalk; *A. catinus* having been the first.

This species is named after Professor Ramsay, of the Geological Survey of Great Britain.

43. AMMONITES FERAUDIANUS, *D'Orb.* Plate XXIII, fig. 6a—c.

[“ *A. testá compressá, transversim costatá: costis inæqualibus, rectis: dorso complanato,*

lateraliter angulato, anfractibus compressis, sub-quadrilateralibus, ultimo $\frac{3.8}{1.00}$; aperturá oblongá, antice truncatá.—*D'Orbigny*, 'Terr. Crét.,' t. i, p. 324.

The species thus described by M. D'Orbigny, in 1840, was said to have been discovered by M. Emeric in the "Craie Chloritées" at Vergons, Basses-Alpes; but in a later work, the 'Prodrome de Paléontologie,' t. ii, p. 98, it is referred to the "Néocomien supérieur ou Urgonien."

The specimen figured in Plate XXIII, fig. 6, was obtained by Mr. Sharpe from the Grey Chalk at Ventnor, in the Isle of Wight, and named by him "*Feraudianus*;" but as no memorandum exists to support this identification, it might possibly have been changed, as it rests upon a single, crushed, and immature specimen.]

44. AMMONITES BRAVAISIANUS, *D'Orb.* Plate XXIII, figs. 7a, b, 8, and 9.

AMMONITES BRAVAISIANUS, *D'Orbigny*. Paléontologie Française, Terrains Crétacés, t. 91, figs. 3 and 4.

A. testá compressá, carinatá, costatá: costis inæqualibus, simplicibus vel bifurcatis, dorsum versus bituberculatis, interruptis: dorso carinato; cariná elevatá, acutá: umbilico magno: aperturá oblongá.

Shell discoidal, with few depressed whorls, which are ornamented by about thirty transverse, slightly flexuous ribs: back keeled: the ribs are unequal, either simple and alternately long and short, or occasionally branching in pairs from the edge of the umbilicus; each rib terminates at the side of the back, where it is ornamented with two smaller tubercles: keel distinct, sharp, and elevated: umbilicus large, allowing two thirds of the inner whorls to be seen: aperture oblong.

Diameter, 1 inch; height of last whorl, $\frac{2}{3}$ inch; width of aperture, $\frac{1}{3}$ inch.

Found in a hard bed of the Middle Chalk, near Dover. In France it has been found in the Upper Green Sand of the department of Vaucluse.

This pretty little Ammonite has some resemblance to *A. varians*, from which it is at once distinguished by the pair of tubercles at the termination of each rib. Moreover, its ribs are simpler than in that species, and never fork on the middle of the side of the whorl. As yet *A. Bravaisianus* has only been found in this country in one bed of rather hard Chalk, which occurs near the bottom of the Chalk with Flints, and contains *A. peramplus*, *Scaphites*, and several other species of Mollusca hitherto undescribed, and only known in that bed.

45. AMMONITES WILTONENSIS, Sharpe. Plate XXIII, fig. 10 *a—c*.

[*A. testá compressá, transversim costatá, costis parvis, numerosis, obtusis, inæqualibus; aperturá elongatá, antice rotundatá; umbilico parvo.* Lat. maj., 13; min., 11; alt., 6 lines.

This figure is taken from a small Ammonite in hard, gritty Chalk, with green stains, stated to have been found near Devizes, by Mr. W. Cunnington. The form is unusual in the Chalk; the ribs are simple, and sub-equal on the back of the shell, but many become obsolete on the sides, the remainder becoming stronger at the umbilicus; the sutural lobes are few and rather simple.]

46. AMMONITES JUKESII, Sharpe. Plate XXIII, fig. 11 *a—e*.

[*A. testá discoideá, late umbilicatá, transversim costatá; costis numerosis, acutis; anfractibus sub-compressis, interdum constrictis; aperturá ovatá.*

This specimen figured is the fragment of an Ammonite which, when perfect, probably measured 5 or 6 inches in diameter; it consists of about one third of the external volution and portions of two inner whorls, which have been detached, and represented separately (fig. 11 *b, c*). The curvature of the ribs is convex towards the aperture; but the figures are not only reversed, but placed upside down. The outer whorl shows one of the periodic constrictions, and another is seen on the inner whorl when detached, and also a more prominent rib on the posterior side of the constriction.

Ammonites Jukesii was discovered by Colonel Portlock, R.E., in the hard Chalk of the county of Londonderry.]

Genus—APTICHUS, *H. Von Meyer*. 1821.*

The operculum [or calcarious plates presumed to have closed the aperture] of certain species of Ammonites, of which there are three forms distinguished by Voltz:

1. *Cornei*, consisting of a single horny plate, of a semi-circular, semi-elliptic, or truncato-ovate form, marked by concentric wrinkles, with a semi-circular notch on the middle of the straight side.

2. *Imbricati*, consisting of a pair of equal plates, each a quarter of a circle, or quarter

* The name *Trigonellites*, given by Parkinson, who described and figured several forms in 1811 ('Org. Rem.,' iii, 184), ought to have been employed. Meyer added nothing to our knowledge respecting them.

of an ellipse, in form, marked on one or both sides by strong concentric lines or wrinkles, produced by the imbricated growth of the shell; each plate has a fold along its straight side, the fold of one plate lapping over that of the other: the plates usually thin.

3. *Cellulosi*, consisting of a pair of plates, similar in form to those of the *Imbricati*, and meeting in the same manner, but thick, and with the convex side cellular in structure.

Few organic remains have given rise to more different opinions than these curious bodies. [Professor Quenstedt regards them as the opercula of *Ammonites*, a view which has been generally adopted in Germany. See Woodward's 'Manual,' 1851, p. 80, and Owen's 'Lectures on the Invertebrata,' 2d edit., 1855, p. 596. In Part I, p. 19, of this Monograph, the *concave* side of the *Aptychus* is incorrectly stated to have been external instead of the *convex* side.]

All the *Aptychi* yet found in the Chalk belong to the group of the *Imbricati*; they have all very thin shells, owing to which they are seldom found perfect; and they are all from the Upper or Middle Chalk.* As there is now little doubt that these bodies really belong to some part of *Ammonites*, I have endeavoured to assign them to their respective species of *Ammonites*, in which I have been guided by a comparison of the form and size of the *Aptychi* with the apertures of the *Ammonites* found in the same beds of the Chalk Formation, and in the same localities, for I am not aware that any *Ammonite* has yet been found in the Chalk containing an *Aptychus* within it. As there are but few species of *Ammonites* known in the Upper and Middle Chalk, the comparison is more satisfactory than might have been anticipated; but the result is only conjectural, as the discovery of other species of *Aptychus* or of *Ammonites* might materially alter our conclusions on this subject.

The species of *Ammonites* known in the Upper and Middle Chalk are *A. Griffithii* and *A. Oldhamii*, only known in Ireland, whence I have seen no *Aptychi*; for which they are excluded from the comparison.

A. Gollevillensis,* found in the Upper Chalk in Ireland and the North of France, and which may consequently be expected to occur here.

| | |
|--|---|
| <i>A. Portlocki</i> ,* | } in the Upper Chalk of Norwich. |
| <i>A. Icenicus</i> ,* | |
| <i>A. Velledæ</i> ,* | |
| <i>A. leptophyllus</i> ,* in the Upper Chalk of Kent and Sussex. | |
| <i>A. peramplus</i> ,* | } in the Middle Chalk of our Southern Counties. |
| <i>A. Woolgari</i> , | |
| <i>A. Bravaisianus</i> , | |

The species marked * have round backs, and belong to Von Buch's family of Ligati. *A. Woolgari* has a serrated keel, and belongs to the Rothomagenses; *A. Bravaisianus*

* Mr. Flower has also found two species in Flint Pebbles in the Gravel, near Croydon.

has a sharp keel, and may be excluded from the comparison, as it is too small to admit any of the *Aptychi* yet found.

As yet we have only seven forms of *Aptychus* from the Chalk, six of which have so many characters in common, that it is natural to suppose that they belong to *Ammonites* of the same, or nearly allied groups; the remaining species, *A. rugosus*, differs in having the convex side strongly ribbed.

In Plate XXIV, which is devoted to this subject, are represented all the known *Aptychi* of the Chalk, and outlines of the openings of the various *Ammonites* to which it seems probable that the *Aptychi* may belong; and, to facilitate the comparison, a dotted line is drawn across each opening. It must be remembered that the two plates of the *Aptychi* did not lie flat in the same plane, but were slightly inclined towards one another [on the inner side], in which position the width they occupied would be rather less than when they are represented lying side by side on the plate.

Among the *Aptychi* belonging to the Chalk, figured by Continental authors, *Aptychus cretaceus*, of Münster, so nearly approaches several of those which are here described, as to show that they belong to nearly allied *Ammonites*. But sad confusion has been made with that specific name. Geinitz gives three figures of *Aptychus cretaceus* ('Charakteristik des Sächsischen Kreidegebirges,' t. 17, figs. 25 *a* and *b* and 26), which evidently belong to three different species; another distinct species is figured under the same name by Reuss ('Versteinerungen der Böhmisches Kreideformation,' t. 7, fig. 13), and both these authors refer to *Aptychus cretaceus*, the plate described under the name of *Anatifa convexa*, by Roemer ('Kreidegebirges,' t. 16, fig. 7), which, if the figures are to be trusted, differs from all the others.

APTYPCHUS LEPTOPHYLLUS, Sharpe. Plate XXIV, fig. 1 *a*, *b*.

A. bivalvis, *subtruncato-ovatus*; *valvis imbricatis*, *latere convexo lævi*, *latere concavo concentricè lineato*; *plicâ mediâ inconspicuâ*.

Bivalve, thin, the united valves ovate, with a slight truncation at the lower end; outer edge reflected: the convex side smooth; the concave side delicately marked by very close, concentric imbrications: medial fold narrow, and but little elevated.

Height, $1\frac{1}{2}$ inch; breadth of each valve, $\frac{1}{2}$ inch.

Found in the Upper Chalk, near Brighton, by Mr. Morris.

The form of this *Aptychus* corresponds to that of the opening of *Ammonites leptophyllus*, and which is also found in the Upper Chalk, near Brighton; for these reasons it is probable that it belongs to that species.

APTYPCHUS PORTLOCKI, Sharpe. Plate XXIV, figs. 2, 3, and 4 (6?)

A. bivalvis, transversim semi-ellipticus; valvis imbricatis, utrinque concentricè sulcatis; sulcis distantibus; plicâ mediâ elevatâ.

Bivalve, the united valves forming, transversely, a semi-ellipse, with a uniform curve to the outer margin; valves thin, marked on both sides by rather distant concentric furrows, produced by the terminations of the broad imbricated additions to their outer edges: medial fold large, and separated from the rest of the valve by a deep furrow.

Height, $\frac{3}{4}$ inch; breadth of each valve, $\frac{1}{2}$ inch.

Found in the Upper Chalk, near Norwich, by Mr. Bayfield; and in a Flint Pebble, in the Gravel, near Croydon.

Of the *Aptychi* yet met with in the Upper Chalk, this species has the transverse diameter of its united valves greatest in proportion to its height; and *Ammonites Portlocki* is the only species known in the Upper or Middle Chalk which has the diameter of its mouth greater than its height (see Plate XXIV, fig. 12). Moreover, the curves of the respective outlines of the two nearly correspond, and both are found in the Upper Chalk, near Norwich. The probability of this *Aptychus* belonging to *A. Portlocki* is therefore very strong.

One of the three forms figured by Geinitz under the name of *Aptychus cretaceus* ('Charakteristik, &c., des Sächsischen Kreidegebirges,' t. 17, fig. 25 a) nearly resembles *A. Portlocki* in outline, but, being a fragment, its proportions are not shown; and it is distinguished by its closely set imbrications from our species.

Anatifa convexa, Roemer, 'Kreidegeb.,' t. 16, fig. 7, is the plate of an *Aptychus* closely approaching *A. Portlocki*; but his figure and description do not enable me to identify them.

APTYPCHUS GOLLEVILLENSIS, Sharpe. Plate XXIV, fig. 5.

A. bivalvis, truncato-ovatus; valvis imbricatis, utrinque concentricè sulcatis; sulcis approximatis; plicâ mediâ elevatâ.

Bivalve, truncato-ovate, the united valves forming about two thirds of the shape of an egg; very convex, especially towards the outer edges: valves thin, marked on both sides by closely set concentric furrows, produced by the terminations of the narrow imbricated additions to the outer edges: medial fold elevated, and sharply separated from the rest of the valve by a deep furrow.

Height, $\frac{5}{8}$ inch; breadth of each valve, $\frac{3}{8}$ inch.

Found in the Upper Chalk of Norwich, by Mr. T. G. Bayfield, and in Flint Pebbles in the Gravel, near Croydon.

Of the Ammonites found in the Upper Chalk, the one of which the outline of the mouth most nearly resembles this *Aptychus* is *A. Gollevillensis* (Pl. XXIV, fig. 15). I have not seen this species of Ammonite from Norwich; but as, besides being found in the North of Ireland, it occurs in France, in the Upper Chalk of the department of the Manche, it may be expected to occur also on our side of the Channel; so that it is probable that the *Aptychus* here described belongs to *Ammonites Gollevillensis*.

Of the varieties of *Aptychus cretaceus* figured by Geinitz, one form (*l. c.*, t. 17, fig. 25 *b*) approaches our species, but does not admit of absolute identification with it.

APTYPCHUS ICENICUS, Sharpe. Plate XXIV, fig. 7 *a*, *b*.

A. bivalvis, ovalis; valvis imbricatis: latere convexo rugis paucis, latis, longitudinalibus, inconspicuis, ornato: plicâ mediâ parvâ.

Bivalve, very thin; oval, with nearly straight sides: valves very convex, especially towards the lower end: the convex side faintly marked by a few broad, longitudinal folds, which are not parallel to one another, and which cross the imbrications: medial fold small and straight: the concave side has not been seen.

Height, $\frac{5}{8}$ inch; breadth of each valve, $\frac{1}{4}$ inch.

Found in the Upper Chalk, near Norwich, by Mr. T. G. Bayfield.

Ammonites Icenicus is the only species yet seen from the Upper Chalk which has its opening corresponding to the peculiar outline of this *Aptychus*, which has its sides nearly straight, and its two extremities nearly equal; and as both are found in the Upper Chalk, near Norwich, there is every probability that they must be connected.

APTYPCHUS RUGOSUS, Sharpe. Plate XXIV, figs. 8 *a*, *b*, and 9.

[*A. bivalvis, truncato-oblongus; valvis imbricatis, latere convexo corrugatis, plicis distantibus, elevatis, tuberculatis, anticè angulariter inflectis.*

Bivalve; together oval or oblong, and notched at each end; separate plates nearly flat, thin, finely imbricated by lines of growth on the concave side, and ornamented with elevated wrinkles on the outer surface; ridges from $\frac{1}{2}$ line to 1 line apart, irregularly tuberculated, sub-parallel with the outer margin, and bent back at a sharp angle at the upper end; slightly irregular and flexuous, and becoming obsolete near the suture.

Height of largest specimen (fig. 9), $2\frac{1}{4}$ inches; breadth of single valve, 11 lines. Small pair (fig. 8), height, $1\frac{1}{4}$ inch; breadth, 1 inch.

From the Upper Chalk of Norwich, in the collections of Mr. John King and Mr. T. G. Bayfield.]

APTYPCHUS PERAMPLUS, Sharpe. Plate XXIV, fig. 10 *a*, *b*.

A. bivalvis; *truncato-ovatus*? *valvis imbricatis, latere convexo corrugatis, latere concavo subtiliter concentricè lineatis: plicâ mediâ elevatâ.*

Bivalve; truncato-ovate? valves imbricated, thin near the medial fold, thicker towards the edge; convex side corrugated, the corrugations covered with irregular and unequal tubercles; concave side marked by fine concentric lines, indicating the edges of the closely set imbrications: medial fold large.

From the Chalk, near Norwich, in the collection of Mr. Bayfield.

I have only one fragment of this *Aptychus*, $1\frac{1}{2}$ inch in breadth, and can offer but an imperfect description of it: the convex side is concealed in the specimen, and the direction of the corrugations cannot be seen. It is with great hesitation that I propose to connect it with *Ammonites peramplus*.

[This specimen was described by Mr. Bayfield in 1851 ('Annals and Magazine of Natural History,' 2d series, vol. viii, p. 236), being the first instance on record of the occurrence of *Trigonellites* in the English Chalk.]

Since the preceding descriptions of the species of *Aptychus* were in type, a memoir* has appeared on the Cretaceous Fossils of Meudon, France, by M. Ed. Hébert, in which three species of *Aptychus* are described; *A. obtusus*, *crassus*, and *insignis*, the last form being closely allied to, if not identical with, *A. rugosus*, above noticed.

* Mém. Soc. Géol. de la France, vol. v, p. 367, pl. 28.

Genus—TURRILITES, *Lamarck*. 1801.

Animal unknown : shell chambered, turreted, usually sinistral, with numerous angular whorls, twisted spirally round a central cavity, and contiguous throughout on their upper and lower sides : chambers separated by transverse, flexuous septa, deeply sinuated towards the edges, and divided into six branching lobes, which are unsymmetrical, those on the outer side of the whorls being much larger than the corresponding lobes on the inner side : spire traversed by a continuous tube, situated on the outer side of the whorl, a little below the suture : mouth of the adult shell produced downwards, and bent over somewhat into the form of a hood.

The genus *Turrilites*, as it has been usually received, includes, in addition to the shells here classed in it, other chambered, turreted species, with contiguous, rounded whorls, and the siphuncle placed on the middle of the outer side of the whorl. I have ventured to remove these species to the genus *Helicoceras*, with which they agree in the round form of their whorls, and in the position of their siphuncle, and only differ in having their whorls contiguous instead of separate. The importance of that difference is destroyed by our finding a species with rounded whorls, *Helicoceras* or *Turrilites polyplocus*, Roemer, in which the whorls are separate during the early part of their growth, contiguous in their next stage, and again separate when full grown ; in consequence of which it has been moved from one to the other genus, according to the part of the spire which was described. M. D'Orbigny had already pointed out that there were two very distinct groups of *Turrilites*, and assigned their characters—1st, the *rotundati*, which are those which I propose to unite to *Helicoceras* ; 2d, the *angulati*, which form the genus *Turrilites*, as here retained.

The produced, arched mouth has not yet been seen in all the *Turrilites*, but there are indications of it in so many species, that it may be presumed to be universal in the genus. I can find no evidence that this mouth was formed more than once during the life of the animal, as is conjectured by M. D'Orbigny ('Terr. Crét.,' p. 570) ; on the contrary, we find that, before the mouth is produced, there is always some modification in the form of the ribs which would betray the previous position of the produced mouth, if such had existed and had been absorbed by the animal ; but no specimens show any such irregularity of the ribs in any of the upper whorls, so that we must conclude that the mouth was only produced once, and the different size of individuals of the same species on which this occurs only show that some reached their adult form sooner than others.

There is very little difference in *Turrilites* between their forms and ornaments in the young and older stages of their growth, excepting near the produced mouth ; so that the species may be recognised in specimens of any size or age.

None of the group of the *rotundati* have been found with the produced mouth like the *Turritites*, and the only modification known in the adult shells of that group is a thickening of the edge of the mouth : probably this will be found to be another generic difference between *Turritites* and *Helicoceras*.

Classification of Turritites.

1. ROTUNDATI, *D'Orb.* Whorls round ; siphuncle near the middle of the exterior side of the whorl ; ribs simple ; mouth thickened.
Common in the Gault.
T. acuticostatus, *D'Orb.* C. C.
2. ANGULATI, *D'Orb.* Whorls angular ; siphuncle near the suture ; mouth covered with a hood.
 - 2 *a.* Lateral lobe trifid ; ribs or tubercles not arranged in regular lines across the whorl.
T. tuberculatus, *Bosc.* L. Chalk.
T. Gravesianus, *D'Orb.* Pl. 144, fig. 3. L. Chalk.
T. Mantelli, *Sharpe.*
 - 2 *a a.* Lateral lobe trifid ; tubercles in regular rows across the whorl.
T. Bergeri, *Brong.* Gault and L. Chalk.
 - 2 *b.* Lateral lobe bifid ; tubercles or ribs arranged in regular lines across the whorl.
T. catenatus, *D'Orb.* Pl. 140, fig. 1. Gault.
T. Puzosianus, *D'Orb.* Pl. 143, fig. 1. Gault.
T. Scheuchzerianus, *Bosc.* L. Chalk.
T. costatus, *Lam.* L. Chalk.
T. Wiestii, *Sharpe.* L. Chalk.
 - 2 *c.* Lateral lobe bifid ; tubercles not in regular rows across the whorl.
T. Morrisii, *Sharpe.* U. G. Sand and L. Chalk.

1. *TURRILITES TUBERCULATUS*, *Bosc.* Plate XXV, figs. 1 to 4, and Pl. XXVI, figs. 15, 16.

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| <i>TURRILITES TUBERCULATUS</i> , <i>Bosc.</i> | Buff. da Déterville, Vers., t. 42, fig. 8. |
| — | — <i>Sow.</i> Min. Conch., t. 74. |
| — | — <i>Mantell.</i> Geol. of Sussex, t. 24, fig. 7. |
| — | — <i>D'Orb.</i> Pal. Franç. Terr. Crét., t. 144, figs. 1, 2. |
| — | — <i>Pictet and Roux.</i> Foss. des Grès Vert de Genève, t. 15, fig. 10. |
| — | <i>VARICOSA</i> , <i>Bosc.</i> l. c., p. 190. |
| — | <i>GIGANTEUS</i> , <i>Haan.</i> Mon. Amm. et Goniât., p. 78. |

T. testá turritá, sinistrorsá : anfractibus numerosis, extrá convexis, tuberculato-spinosis : tuberculis 4-serialibus ; serie superiori, in medio anfractuum, tuberculis 20 distantibus, maximis, spinosis ; seriebus tribus inferioribus propé suturam tuberculis parvis, numerosis, approximatis : angulo spirali 16°—20°.

Shell turreted, with a spiral angle of 16° to 20°, sinistral : whorls numerous, rounded externally, with one row of above 20 very large spinose tubercles near their middle, and three rows of numerous small tubercles near their base, the lowest of which three rows is concealed by the suture ; the tubercles of the middle row have a rounded base, those of the three lower rows are elongated in a direction parallel to the suture, and are of the same number in each row : upper and lower sides of the whorls ornamented with faint, radiating ribs, corresponding to the tubercles of the lowest row : umbilicus narrow : section of the whorls nearly rhomboidal, with the outer side convex : mouth somewhat produced, and rising to a blunt point on the inner side of the whorl, and surrounded by a wing-shaped expansion, with a nearly semicircular outline.

The figures 1 and 4 represent the usual form of this species, with nearly twice as many tubercles in the lower rows as there are in the upper one ; but specimens are often found like fig. 3, with less difference between the different rows in the size and number of the tubercles, and with the two lower rows of tubercles almost coalescing. I have seen no specimen in which these two varieties are found in the same individual, as is represented in M. D'Orbigny's fig. 1 ; but as the lobes of the septa of the two forms closely correspond, we must presume that they belong to the same species. In very large individuals the tubercles of the upper row are fewer in number, and proportionably larger.

The lobes of the septa are much divided and branching ; the outer side of the whorl holds half of the dorsal lobe, the dorsal saddle, and half of the superior lateral lobe, which last has five principal branches ; the dorsal saddle is divided into two nearly equal parts, and each of these is divided into two nearly equal branches (fig. 15). This is the character by which *T. tuberculatus* is best distinguished from *T. Gravesianus*, which has the dorsal saddle divided into two very unequal parts, only the upper of which is again divided.

The larger specimens of *Turritiles* are never found perfect, so that their length must be

calculated. The specimen of this species figured in the 'Mineral Conchology' has a diameter of 5 inches in the lower whorl, and must have been above 18 inches long. The common-sized specimens have their largest diameter about $2\frac{1}{2}$ inches, and probably reached 9 or 10 inches in length.

Common in the Grey Chalk of the South of England, and in the Chloritic Marl of the Isle of Wight, and the Chalk with siliceous grains, of Dorset and Somerset.

2. *TURRILITES GRAVESIANUS*, *D'Orbigny*. Plate XXV, fig. 7, and Plate XXVI, fig. 14.

TURRILITES GRAVESIANUS, *D'Orb.* Pal. Franç. Terr. Crét., t. 144, figs. 3—5.

— *TUBERCULATUS*, *Mantell.* Geol. of Sussex, t. 24, fig. 6.

T. testá turrito-conicá, sinistrorsá; anfractibus paucioribus, extrá angulato-convexis, tuberculato spinosis; tuberculis 4 serialibus; serie superiore, in medio anfractuum, tuberculis 10—12 maximis, spinosis, distantibus; seriebus tribus inferioribus propé suturam tuberculis parvis, numerosis, approximatus; angulo spirali 30°.

Shell conical, with a spiral angle of about 30°, sinistral: whorls few, externally convex, and somewhat angular in the middle, with one row of 10 or 12 very large spinose tubercles a little above their middles, and three rows of numerous small tubercles near their base; the two lowest of these rows are so near together that the tubercles almost coalesce, and are partially concealed by the suture; the tubercles of the upper row have a rounded base, those of the other three rows are elongated in a direction parallel to the suture, and are of the same number in each row: upper and lower sides of the whorls ornamented with radiating ribs, corresponding to the tubercles of the lowest row: umbilicus narrow: section of the whorls somewhat pentagonal: the perfect mouth has not been seen.

The lobes of the septa are much divided, and form a very complicated pattern; the dorsal lobe, dorsal saddle, and nearly two thirds of the superior lateral lobe are visible on the outer side of the whorl; the latter has four principal branches, of very unequal size: the dorsal lobe is short; the dorsal saddle is very large, and unevenly divided, the upper half having two principal branches, of which the upper ends in three, the lower in two terminal branchlets; the lower half of the dorsal saddle has only one undivided straight branch, parallel to the siphuncle: this peculiarity in the dorsal saddle distinguishes the species from *T. tuberculatus*; the superior lateral lobe is very large, and is divided into five large branches (Plate XXVI, fig. 14).

Diameter of the largest whorl, $1\frac{3}{4}$ inch; presumed length, 5 inches.

Rare in the Grey Chalk, near Lewes, and in the Chloritic Marl of Ventnor, Isle of Wight.

The external form of this species is very similar to that of *T. tuberculatus*, with which

it was long confounded. M. D'Orbigny pointed out the distinctions between them, which consist in the shorter and blunter spire, fewer and larger tubercles of *T. Gravesianus*. Slightly crushed specimens of *T. tuberculatus* are sometimes very difficult to distinguish from *T. Gravesianus*, unless the outline of the septa can be traced, when the different forms of the dorsal saddles set all doubts on the subject immediately at rest.

3. TURRILITES MANTELLI, *Sharpe*. Plate XXV, figs. 5 and 6.

T. testâ turritâ, sinistrorsâ: anfractibus numerosis, extrâ convexis, tuberculatis: tuberculis 4 serialibus; serie superiori, in medio anfractuum, tuberculis 20—24, basi rotundatis; seriebus tribus inferioribus, tuberculis 30 minoribus, basi elongatis, approximatis: angulo spirali 18°—20°.

Shell turreted, with a spiral angle of 18° to 20°, sinistral: whorls numerous, convex externally, with one row of 20 to 24 tubercles near their middle, and three rows of about 30 smaller tubercles near their base, the lowest of which rows is hid by the suture; the tubercles of the middle row have a rounded base, those of the three lower rows are elongated in a direction parallel to the suture, and are of the same number in each row: upper and lower sides of the whorls ornamented with radiating ribs, corresponding to the tubercles of the lower row: umbilicus narrow: mouth somewhat produced, and rising to a blunt point on the inner side of the whorl, and surrounded by a broad, wing-shaped expansion of somewhat rhomboidal form.

Only a small part of the outline of a septum has been seen, which is shown on the upper whorl of fig. 5; the dorsal saddle is divided into two unequal parts, which are intermediate in form between those of *T. tuberculatus* and *T. Gravesianus*, more nearly resembling the latter.

Diameter of last whorl, $2\frac{1}{2}$ inches; probable length, 12 inches.

Rare in the Grey Chalk, near Lewes, Sussex.

This species is readily distinguished from *T. tuberculatus* by the greater number and smaller size of the tubercles of the upper row, which are almost as numerous as those of the three lower rows. There is also a marked difference in the rhomboidal form of the expanded margin of the mouth. These distinctions will probably be strengthened when a more complete view is obtained of the lobes of the septa.

The only specimens which I have seen were collected by Dr. Mantell, and are now in the British Museum. The specific name is therefore a just tribute to the memory of that zealous geologist.

4. TURRILITES SCHEUCHZERIANUS, *Bosc.* Plate XXVI, figs. 1—3.

TURRILITES SCHEUCHZERIANUS, *Bosc.* Buffon du Deterville, vol. v, p. 190.

— UNDULATUS, *Sow.* Min. Con., t. 75, figs. 1—3.

— — *Mantell.* Fossils of the South Downs, t. 23, figs. 14 and 16; t. 24, fig. 8.

— — *Geinitz.* Kreide, t. 13, figs. 1—3.

— — *D'Orb.* Paléont. Franç. Terr. Crét., t. 146, figs. 3, 4.

— DESNOYERSI, *D'Orb.* Paléont. Franç. Terr. Crét., t. 146, figs. 1, 2.

T. testá turritá, sinistrorsá: anfractibus numerosis, extrá rotundatis, costatis: costis numerosis, sub-angulatis; junioribus interruptis; adultis continuis: angulo spirali 15°—18°.

Shell turreted, with a spiral angle of 15° to 18°, sinistral: whorls numerous, rounded externally, crossed by 20 to 24 sharp, elevated ribs; on the upper whorls the ribs are nearly straight, and broken into two unequal parts by a depression a little below their middle; towards the middle of the shell the depression gradually disappears, and on the lower whorls the ribs continue uninterruptedly across the whorl, and become more and more flexuous: upper and under sides of the whorls smooth: umbilicus very small: mouth produced considerably downwards, partially arched over, and expanded towards the umbilicus: the outline of the septa has not been seen.

Diameter of last whorl, $1\frac{3}{4}$ inch; estimated length, 8 inches.

Common in the Grey Chalk, wherever that bed occurs, in the South of England.

This species is so well distinguished from all the other Turrilites by its elongated form and comparatively simple ribs, that it had remained free from all confusion, until M. D'Orbigny unfortunately proposed the specific name of *T. Desnoyersi* for its young form, and gave an appearance of probability to his suggestion by representing both the young and the old forms as full grown shells on his plate 146, without any variation in the ribs during the growth of either.* Such errors are the natural consequence of what is called *restoring* the entire form of a shell from a fragment, instead of representing what is actually seen. Dr. Mantell had already given an admirable figure of a nearly perfect specimen, exhibiting the change from the broken ribs of the upper whorls to the unbroken ribs of the older whorls, which ought to have preserved M. D'Orbigny from this unnecessary addition of a synonym.

Figure 2 represents a young shell, with ribs still divided, which is already beginning

* Figures 1 and 3, plate 146, are both stated to be "restauré sur un échantillon de ma collection." *D'Orb.*, 'Terr. Crét.,' vol. i, pp. 602 and 604.

to form a mouth like an adult, with the ribs becoming flexuous. A still younger shell, with the produced mouth completed, is shown in fig. 3; but as this specimen has the lower side of the whorl strongly ribbed, it may be doubted whether it belongs to the same species.

5. *TURRILITES MORRISII*, *Sharpe*. Plate XXVI, figs. 4—8.

T. testá turritá, sinistrorsá: anfractibus numerosis, extrá planiusculis tuberculatis: tuberculis 3 vel 4 serialibus; serie superiori, in medio anfractuum, tuberculis 8—12 majoribus, distantibus; seriebus inferioribus propé suturam, tuberculis minoribus, numerosis: angulo spirali 15°.

Shell turreted, with a spiral angle of about 15°, sinistral: whorls numerous, nearly flat externally, with one row of 8 to 12 large tubercles near their middle, and two or three rows of above 20 smaller tubercles near the suture, all of them with a round base: upper and lower sides of the whorls ornamented with faint, radiating ribs, corresponding to the tubercles of the lowest row: umbilicus very narrow: section of the whorls rhomboidal: septa with the superior lateral lobe bifid, with four branches on each side, and the dorsal saddle divided into two very unequal parts: the perfect mouth has not been seen.

In the young shell the three lower rows of tubercles are usually distinct; in older shells the tubercles of the two lower rows gradually coalesce, and at last hardly more than one row can be distinguished, close to the suture.

Largest diameter, $1\frac{1}{4}$ inch; probable length, 6 inches.

Common in the Chloritic Marl of the Isle of Wight, and in the Chalk with siliceous grains, Chardstock, Somersetshire.

6. *TURRILITES BERGERI*, *Brongniart*. Plate XXVI, figs. 9—11.

TURRILITES BERGERI, *Brong.* Env. de Paris, t. 7, fig. 3.

— — *D'Orb.* Pal. Franç. Terr. Crét., t. 143, figs. 3—6.

T. testá turritá, sinistrorsá (vel dextrorsá?): anfractibus paucioribus, rotundatis, tuberculatis: tuberculis 4 serialibus, æquidistantibus, æqualibus: aperturá rotundato-rhomboideá.

Shell turreted, turned to the left: whorls not very numerous, increasing rapidly in size, rounded, and ornamented with four equidistant rows of numerous, rounded tubercles, which are of the same number, and nearly the same size in each row; only three rows are

exposed, the upper one being covered by the next whorl; the tubercles are so placed as to appear to form sloping, transverse bands across the whorls: section of the whorls somewhat rhomboidal: septa, and position of the siphuncle, unknown.

Spiral angle about 35° .

Diameter of the largest specimens from Chardstock, in Mr. Wiest's collection, 3 inches.

This is a well-marked shell, which can hardly be confounded with any other species. We have not met with any specimen turned to the right like that figured by M. D'Orbigny, t. 143, fig. 6.

Abundant in the Chalk with green grains, at Chardstock. (*Mr Wiest.*)

7. TURRILITES BECHII, Sharpe. Plate XXVI, fig. 13.

T. testá turritá, sinistrorsá: anfractibus paucioribus, extrá rotundatis, costatis, tuberculatisque: costis numerosis, superioribus, flexuosis, tenuibus, infrá interruptis: tuberculis biserialibus, inferioribus, numero costarum æqualibus: angulo spirali 30° .

Shell turreted, sinistral, with a spiral angle of 20° : whorls few, externally rounded, prettily ornamented with numerous delicate, flexuous ribs, which extend from the suture across the upper two thirds of the whorl, where they are interrupted by a smooth space, in which are two rows of tubercles, elongated in the direction of the suture, and equal in number to the ribs; below these the ribs appear again, bending backwards over the lower side of the whorl; thus each rib, with its corresponding pair of tubercles, forms a flexuous line across the outer and the under sides of the whorl: umbilicus small: the outline of the septa has only been partially seen; the dorsal saddle is divided into two slightly unequal parts: the specimen figured shows the beginning of a produced mouth.

Diameter of last whorl, 1 inch; estimated length, 4 inches.

Only one specimen has been seen, which was found in the Chalk with siliceous grains, near Lyme Regis, by Sir H. T. de la Beche, and by him presented to the British Museum: it is named in honour of his memory.

8. TURRILITES COSTATUS, Lamarch. Plate XXVII, figs. 1—5, and 15, 16.

TURRILITES COSTATUS, *Lamk.* 1801. An. sans Vert., p. 102.

— — *Sowerby.* 1813. Min. Conch., t. 36.

— — *Brong.* 1822. Env. de Paris, p. 83, t. 7, fig. 4.

— — *Mantell.* 1822. Geol. of Sussex, t. 23, fig. 15.

— — *D'Orbigny.* Paléont. Franç., Terr. Crét., t. 145.

— TRIPLICATUS, *J. Sow.* In Dixon's Geol. of Sussex, t. 29, fig. 16.

T. testá elongato-turritá, sinistrorsá, costatá et tuberculatá; anfractibus convexius culis, inferné costatis, superné bituberculatis; costis tuberculisque numero aequalibus; aperturá ovali; umbilico minimo.

Shell turreted, turned to the left, with a spiral angle of about 25° ; whorls slightly convex, separated by a moderately impressed suture, and ornamented on their lower half by numerous straight, elevated ribs, which rise at their upper ends into round tubercles, and then terminate abruptly at a smooth spiral band, which encircles the shell; above are two rows of tubercles, the upper of which are smaller, and concealed by the next whorl; ribs and tubercles equal in number; aperture oval, higher than broad; umbilicus very small.

[The complicated form of the septa in this species is represented in Pl. XXVII, fig. 15.]

In Dixon's 'Geology of Sussex,' a Turrilite is described under the name of *T. triplicatus*, J. Sow., which appears to be a variety of the above. [This specimen is figured in Pl. XXVII, fig. 15.]

Found in the Chalk Marl of Ventnor, Isle of Wight; and in the Chalk with green grains, at Chardstock.

9. TURRILITES BIFRONS? *D'Orb.* Plate XXVII, figs. 6, 7.

[T. testá turritá, elongatá, sinistrorsá; anfractibus convexiusculis, sulco longitudinaliter ornatis; transversim costatis; costis curvatis, interruptis, biseriatis, anterioribus ad suturam divisis.]

The specimens figured differ from the ordinary examples of *T. costatus* in the flattening of the whorls, occasioned by the shallow furrow which divides the curved transverse ribs into a double series: the ribs are simple, rounded, and about as wide as the interspaces; the lower series of ribs is again divided by a furrow exactly at the suture, forming a third set of little tubercles, only visible on the base of the shell when broken.

Found in the Lower Chalk, of Ventnor, Isle of Wight.]

10. TURRILITES WIESTII, *Sharpe.* Plate XXVII, fig. 8, 9 *a, b*, and fig. 17.

T. testá turritá, sinistrorsá; anfractibus externis rotundatis, tuberculatis, intus lævibus; tuberculis conicis 4 serialibus, numero equalibus, superiore et inferiore minoribus, in suturá profundá crenulatá, coalescentibus, mediis binis majoribus prominentibus; aperturá subquadratá; umbilico parvo.

Shell turreted, tuberculated; spine turned to the left, with a spiral angle of about 22° ; whorls rounded, separated by a deep, crenulated suture, ornamented with four rows of conical tubercles, which are of the same number in each row, and set obliquely under one

another, without ribs between them; the tubercles of the two outer rows are smaller than the others, and meet at the junction of the valves, forming a crenulated suture; while the tubercles of the two middle rows, which are nearly equal, are prominent on the side of the whorls; surface of the whorls between the tubercles smooth; aperture nearly square; umbilicus small.

The largest specimen seen has a diameter of $1\frac{1}{4}$ inch, which requires a length of 4 or 5 inches.

As yet we have only seen it from the Chalk with green grains, where it is very abundant.

This elegant shell is at once distinguished from *T. tuberculatus* by having the same number of tubercles in each row, in which it agrees with *T. Bergeri*. From this it differs in the shape of the whorl, and the position of the lower row of tubercles, which is at the suture instead of projecting at the side of the whorl: in consequence of this, it has only two rows of tubercles visible instead of three on the side of the whorl.

Found in the Grey Chalk, of Ventnor, Isle of Wight; and also in the Chalk with green grains, at Chardstock, Somersetshire; and at Chaldon and Man-of-War Cove, Dorsetshire.

11. TURRILITES PUZOSIANUS, D'Orb., var.? Plate XXVII, fig. 11.

? TURRILITES PUZOSIANUS, D'Orbigny. Terr. Crét., pl. 143, figs. 1, 2.

T. testá turritá, sinistrorsá; anfractibus externi planiusculis, costulatis, tuberculatis; costis numerosis, flexuosis, obliquis, supernè interruptis tuberculatisque; tuberculis bi-serialibus, seriis superioris binis, inferioris longitudinaliter compressis; aperturá ovali; umbilico parvo.

Shell turreted; spine turned to the left, with a spiral angle of about 15° ; whorls flattish, with the lower angle rounded off, separated by a moderate suture, and ornamented with numerous oblique, flexuous, slight ribs, interrupted near the top of the whorl by a smooth spiral band, on each side of which the ribs rise into longitudinally flattened tubercles; the tubercles of the upper row bifid or double, and stand at the angle of the whorl; aperture somewhat oval; umbilicus small.

I have as yet only seen one fragment of this shell. It resembles *T. Puzosianus*, D'Orb., in having ribs rising into tubercles on each side of a smooth band, which, running round the upper part of the whorl, divides the ribs into two unequal parts. Our shell differs from *T. Puzosianus* in the flexure of the ribs, and in the position of the upper row of tubercles, which, in that species, is placed at the suture, and thus concealed by the next whorl; but in this one it is at the upper angle of the whorl, and always prominent. It differs from *T. costatus* in the flexure of the ribs and flatness of the whorls.

Found in the Chloritic Marl, of Bonchurch, Isle of Wight.



PLATE XVII.

Fig. *Acanthoceras sherborni* Spath, Geol. Mag. 63, 1926, p. 82.
 1a and b. AMMONITES CENOMANENSIS; from the Grey Chalk of Dover; reduced to two thirds its natural diameter; in the collection of J. S. Bowerbank, Esq., p. 37.

1a, side view.

1b, front view.

Protacanthoceras jukes-brownei Spath, Geol. Mag. vol. 63, 1926, p. 82.

2. AMMONITES HIPPOCASTANUM; from the Lower Chalk of Man of War Cove, Dorsetshire; in the collection of E. H. Bunbury, Esq., p. 37.

3a and b. AMMONITES HIPPOCASTANUM, young; from the Lower Chalk of Chardstock; in the collection of E. H. Bunbury, Esq., p. 37.

3a, side view.

3b, front view.

4a, b, and c. AMMONITES HIPPOCASTANUM; a fragment, from the Lower Chalk of Chardstock; in the collection of E. H. Bunbury, Esq., p. 37.

4a, back view.

4b, side view.

4c, outline of a septum.

(not *A. goupilianus* d'Orbigny)

5a and b. AMMONITES GOUPILIANUS; from the Lower Chalk of Sussex; in the British Museum, from the collection of Dr. Mantell, p. 38.

6. AMMONITES GOUPILIANUS; outline of a septum, copied from Pl. xciv of M. D'Orbigny's 'Paléont. Franç. Terr. Crét.,' p. 38.

Scaligeria ~~sp.~~ *Schlüteria* Gross. sp. *bergense* Gross. 1894

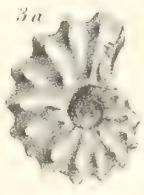
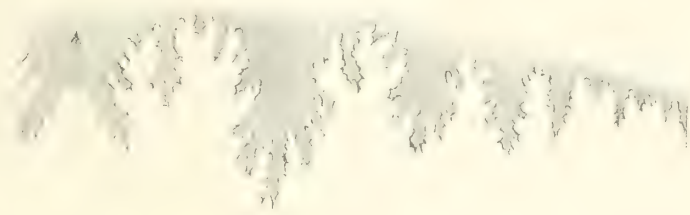
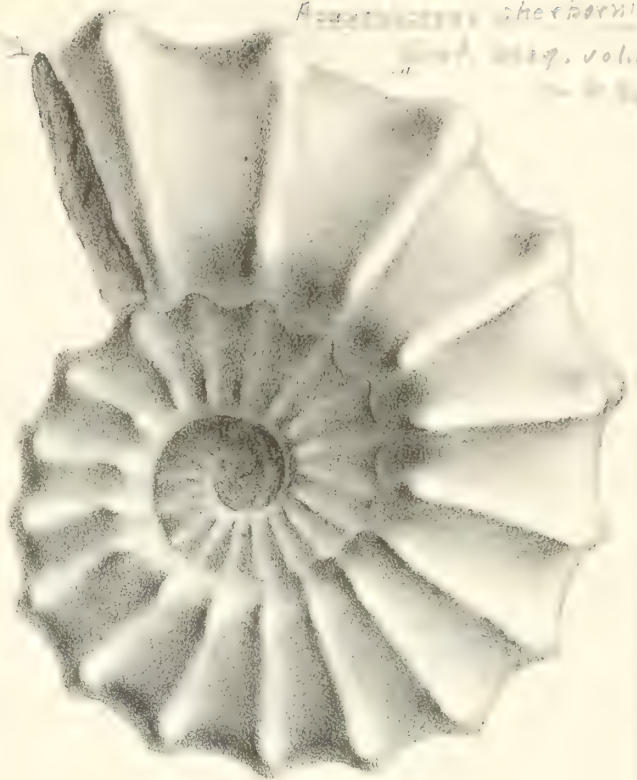
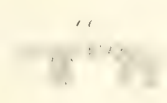
7a and b. AMMONITES VELLEDE; from the Upper Chalk near Norwich; in the collection of F. G. Bayfield, Esq., of Norwich, p. 39.

7a, side view. N.B. The umbilicus is represented too large, the artist having been deceived by the breaking away of the soft chalk.

7b, front view.

Aspidiotrypa cherborni

Geol. Mag. vol. 6



Aspidiotrypa cherborni
(Geol. Mag. vol. 6)

PLATE XVIII.

Mantelliceras cantianum Spath. (lectotype) 5 see *Geol. Mag.* Vol. 63, 1926
Fig. p. 82 (no. 740).

1. AMMONITES (NAVICULARIS;) from the Grey Chalk of White Nore, Dorsetshire; in the collection of E. H. Bunbury, Esq., p. 39.

2. AMMONITES NAVICULARIS; from the Grey Chalk near Lewes; in the collection of Henry Catt, Esq., p. 39.

3a and b. AMMONITES NAVICULARIS; from the Lower Chalk of Chardstock; in the collection of John Morris, Esq., p. 39.

3a, front view.

3b, side view.

4a and b. AMMONITES MANTELLI; from the Grey Chalk of Bonchurch, Isle of Wight; in the collection of S. Saxby, jun., Esq., p. 40.

4a, side view.

Sec. Monogr. 44, p. 114, Hyatt

4b, front view.

5a, b, and c. AMMONITES NAVICULARIS; from the Lower Chalk of Chardstock; in the collection of John Morris, Esq., p. 39.

5a, side view.

5b, front view.

5c, front view of the inner whorl of the same specimen.

6a and b. AMMONITES MANTELLI; from the Chloritic Marl of the Isle of Wight; in the collection of John Morris, Esq., p. 40.

6a, side view.

Mantelliceras tuberculatum (Spath.) ac.

6b, front view.

7a, b, and c. AMMONITES MANTELLI; from the Chloritic Marl of Bonchurch, Isle of Wight; in the collection of S. Saxby, jun., Esq., p. 40.

7a, side view.

Mantelliceras mantelli (Sharpe) ac. spath.

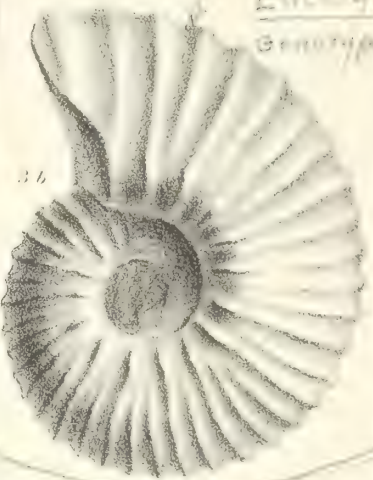
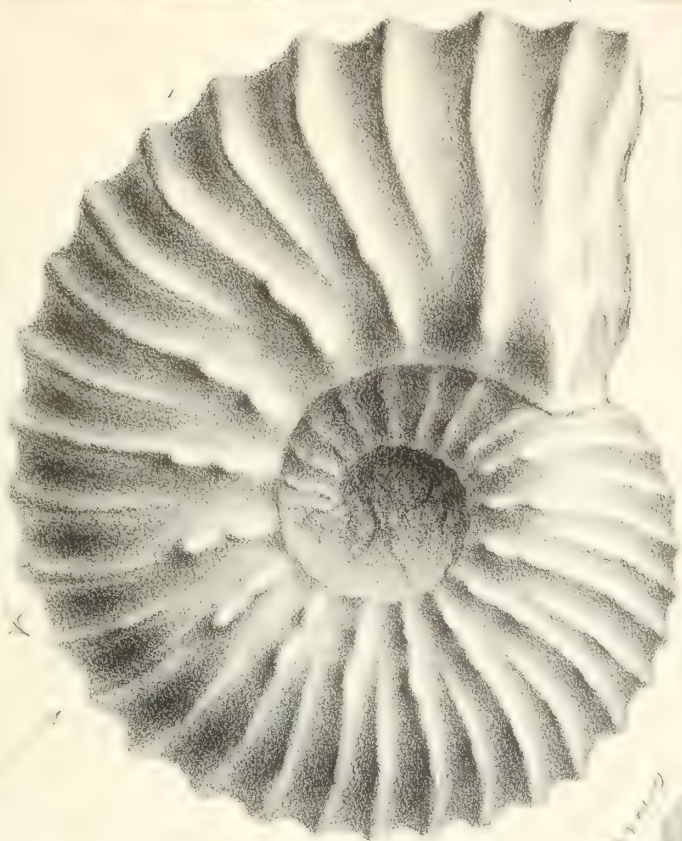
7b, front view.

7c, outline of septum.

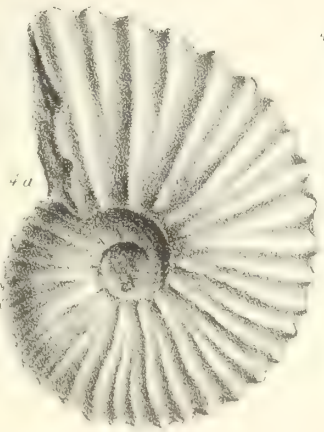
Geol. Mag.

8. AMMONITES NAVICULARIS; outline of the septum of the specimen fig. 1, above.

Montaliviana cantianum Spath



Eucalyptus cantianum
Genotype, Spath
(1924)



Montaliviana cantianum
Genotype, Spath
(1924)



Montaliviana cantianum
Genotype, Spath
(1924)

Montaliviana cantianum Spath

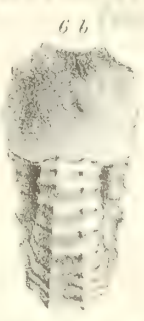
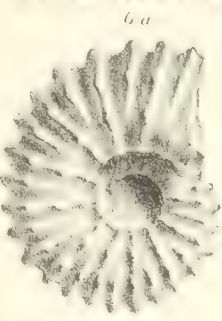


PLATE XIX.

Fig.

1*a*, *b*, and *c*. AMMONITES COUPEI; *var.*, from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 23. *vactonense S. Hill*
upper Cenomanian

1*a*, side view.

1*b*, back view.

1*c*, section of a whorl.

2*a*, *b*, and *c*. AMMONITES RENAUXIANUS; a young shell, from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 41.

2*a*, side view.

2*b*, back view.

3*c*, front view of inner whorl of the same specimen.

3*a* and *b*. AMMONITES OCTO-SULCATUS; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 42.

3*a*, side view.

3*b*, front view.

4*a* and *b*. AMMONITES ICENICUS; from the Upper Chalk, near Norwich; in the collection of Mr. King of Norwich, p. 43.

4*a*, side view, showing the outline of a septum.

4*b*, front view.

5*a* and *b*. AMMONITES DEVERIANUS; from the Grey Chalk of Sussex; in the British Museum, from the collection of F. Dixon, Esq., p. 43.

5*a*, side view.

5*b*, front view.

6. AMMONITES VELLEDAE; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 39.

6, outline of a septum.

Pseudacompoceras
rectense sp. n.
1925, p. 197

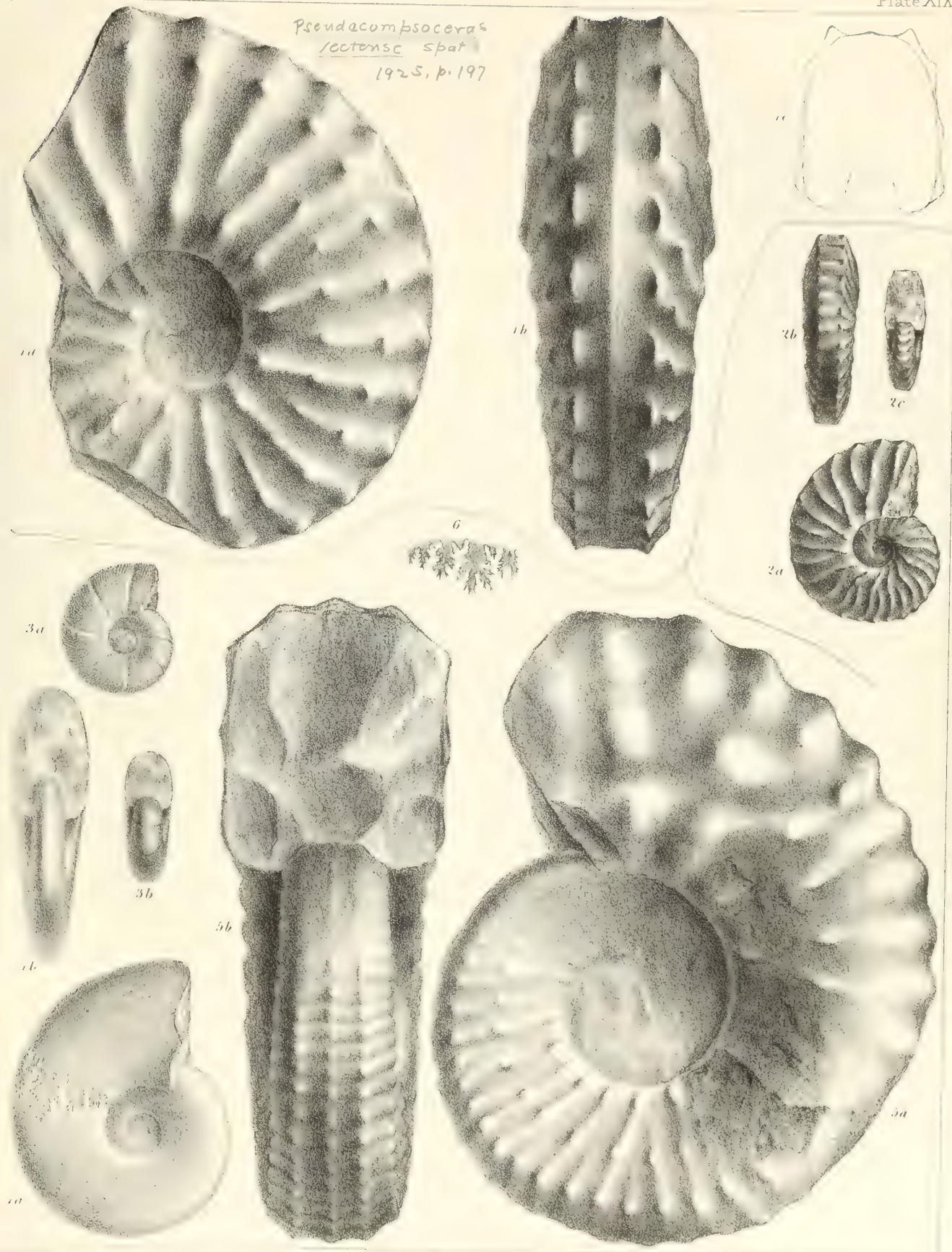


PLATE XX.

Fig.

1*a*, *b*, *c*. *AMMONITES RUSTICUS* ; from the Lower Chalk, near Lyme Regis ; in the Museum of Practical Geology ; reduced to two thirds its natural diameter, p. 44.

The surface of the inner part has decayed away.

1*a*, side view.

1*b*, back view.

1*c*, section of the outer whorl.

2*a*, *b*, and *c*. *AMMONITES RENEVIERI* ; from the Grey Chalk, near Blackdown, Isle of Wight ; in the collection of E. Renevier, Esq., of Lausanne, p. 44.

2*a*, side view.

2*b*, front view.

2*c*, outline of a septum.

3*a* and *b*. *AMMONITES SAXBII* ; from the Grey Chalk of Ventnor, Isle of Wight ; in my possession, p. 45.

3*a*, side view.

3*b*, front view.

4*a* and *b*. *AMMONITES VECTENSIS* ; from the Chloritic Marl of Ventnor, Isle of Wight ; in my possession, p. 45.

4*a*, side view.

4*b*, front view.

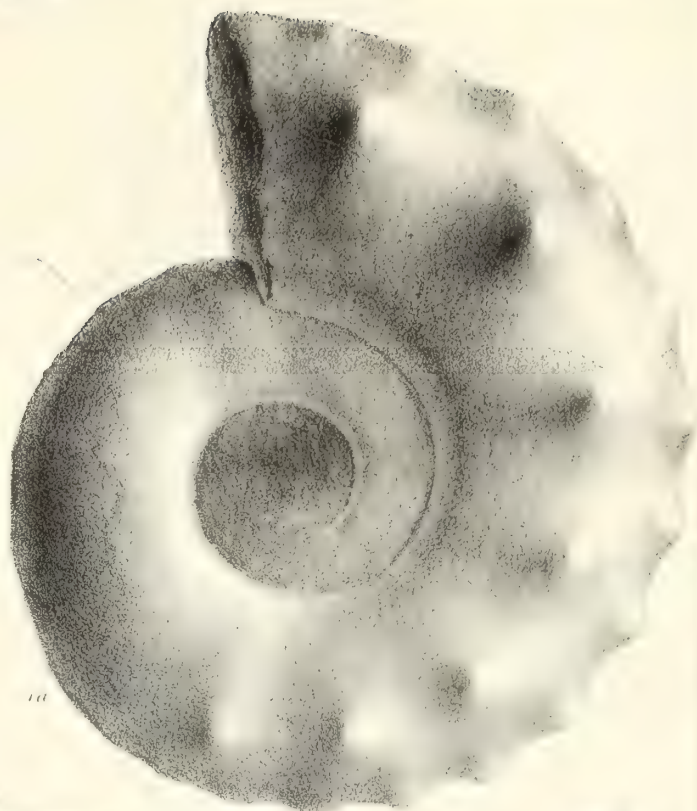


1b

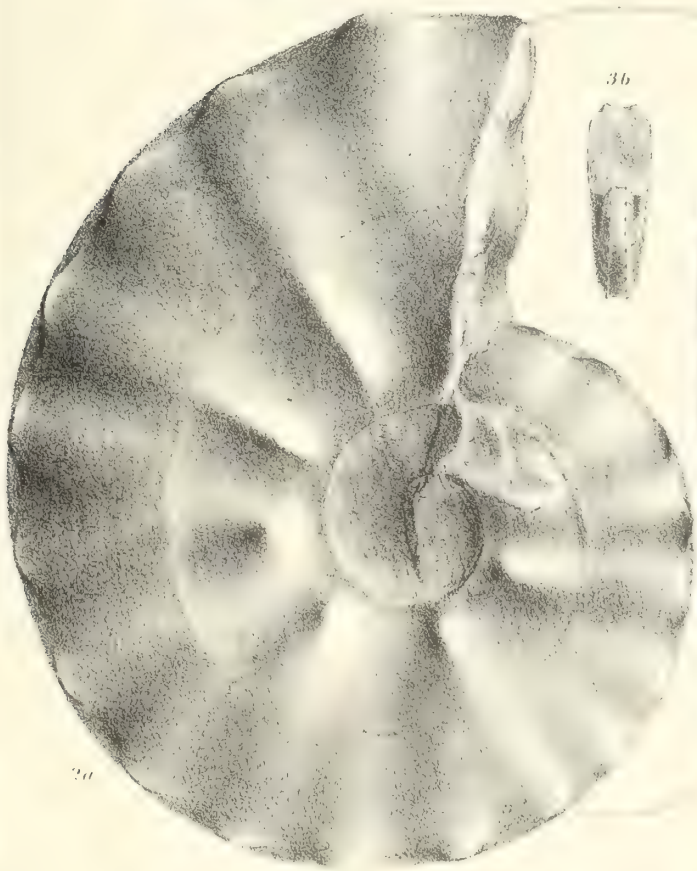


23 diam.

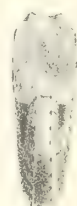
2c



1a



2a



3b



2b



3a



1b



3a

PLATE XXI.

Fig.

1*a, b, c.* AMMONITES LEWESIENSIS; from the Grey Chalk, near Dover; in the collection of S. J. Mackie, Esq., of Folkstone, p. 46.

1*a*, side view.

1*b*, front view.

1*c*, outline of a septum.

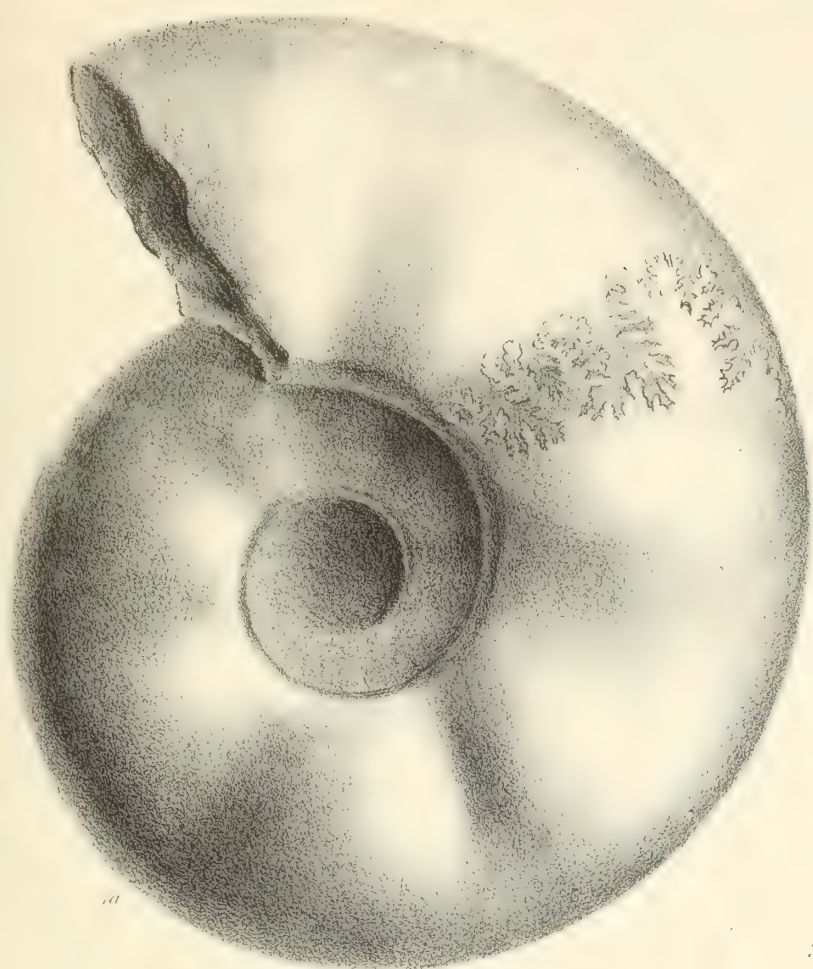
2. AMMONITES LEPTOPHYLLUS; outline of a septum of the specimen, Plate XXII, fig. 1.

3*a, b, c.* AMMONITES WIESTII; from the Chalk with silicious grains, Chardstock, Somersetshire; in the collection of J. Wiest, Esq., p. 47.

3*a*, side view.

3*b*, back view.

3*c*, section of a whorl.

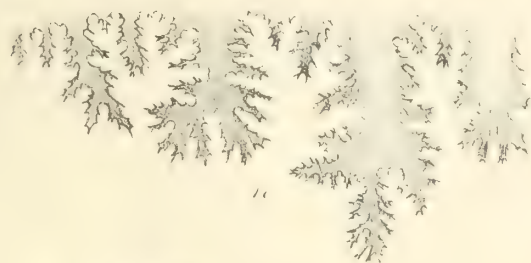


1a

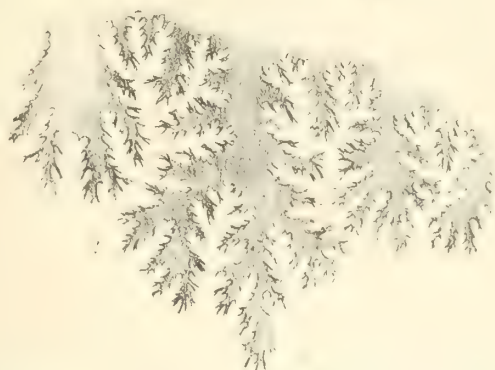


1b

3c



2a



3b



3c

PLATE XXII.

Fig.

1*a*, *b*. AMMONITES LEPTOPHYLLUS; from the Upper Chalk of Greenhithe, Kent; in the collection of L. Barrett, Esq., reduced to two fifths its natural diameter, p. 48.

1*a*, side view.

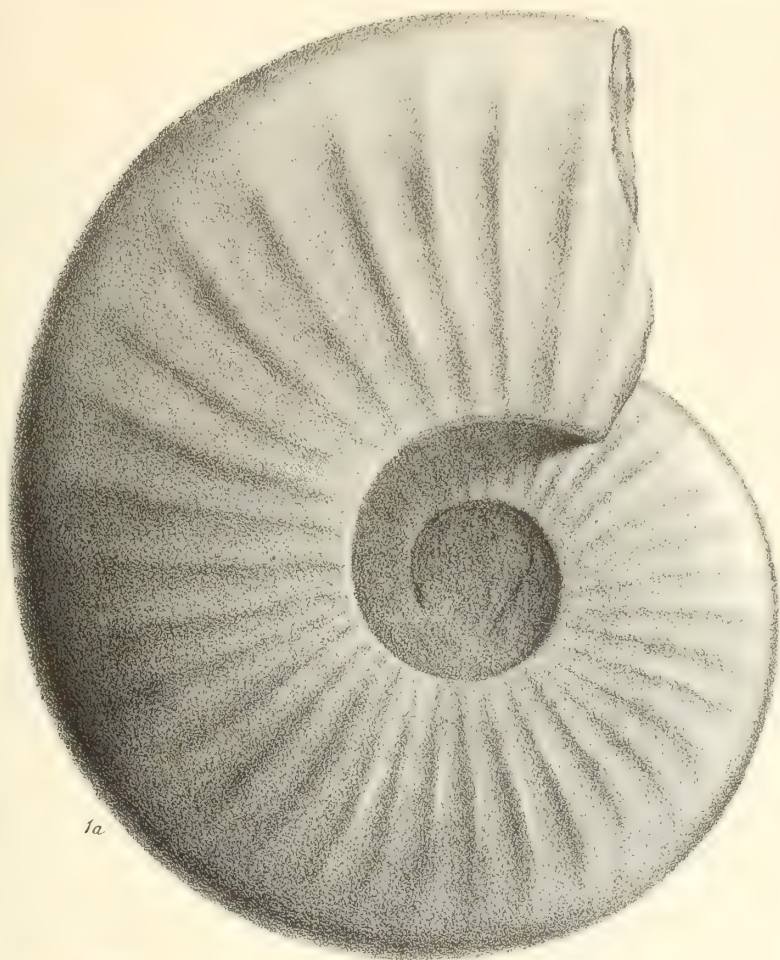
1*b*, front view.

2*a*, *b*, *c*. AMMONITES GOLLEVILLENSIS; from the hard Chalk of Damlaght, in the county of Derry, Ireland; in the Museum of Practical Geology; reduced to three fourths its natural diameter, p. 48.

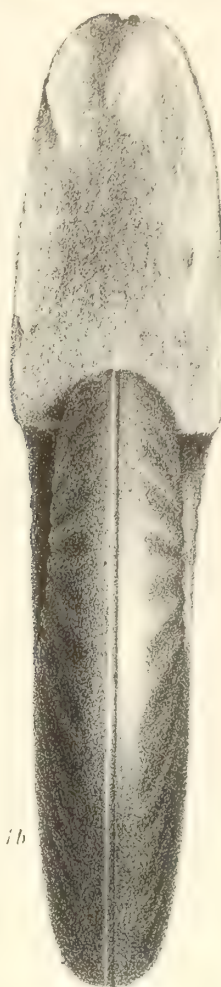
2*a*, side view.

2*b*, front view.

2*c*, outline of a septum.

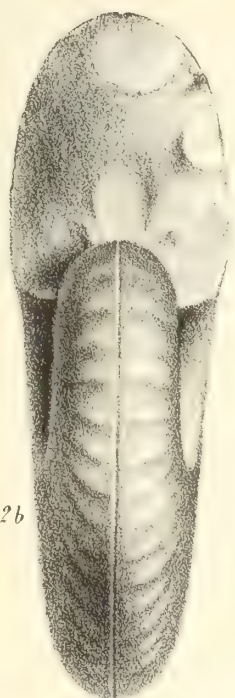


1a

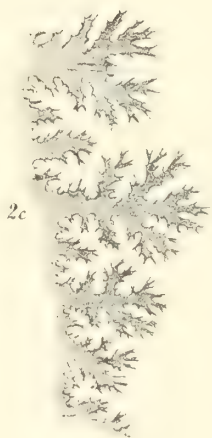


1b

$\frac{2}{3}$ diam.

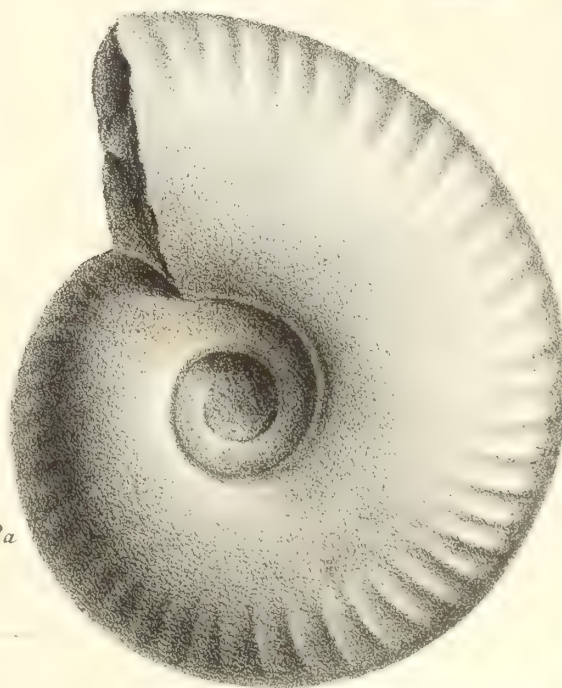


2b



2c

$\frac{1}{4}$ diam



2a

PLATE XXIII.

Fig.

- 1*a, b, c.* AMMONITES CURVATUS; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 49.
1*a*, side view.
1*b*, front view.
1*c*, outline of a septum.
2. AMMONITES FALCATUS; outline of the septum of a specimen from the Chloritic Marl of Ventnor, Isle of Wight; in my possession, p. 21.
- 3*a, b, c.* AMMONITES SALTERI; from the Chalk with siliceous grains, Chardstock, Somersetshire; in the collection of J. Wiest, Esq., p. 50.
3*a*, side view.
3*b*, front view.
3*c*, outline of a septum.
- 4*a, b, c.* AMMONITES RAMSAYANUS; from the Chalk with siliceous grains, Chardstock, Somersetshire; in the collection of J. Wiest, Esq., p. 51.
4*a*, view of the left side.
4*b*, view of the right side.
4*c*, front view.
- 5*a, b.* AMMONITES SALTERI; from the Chalk with siliceous grains, Chardstock, Somersetshire; in the collection of J. Wiest, Esq., p. 50.
5*a*, side view.
5*b*, front view.
- 6*a, b, c.* AMMONITES FERAUDIANUS; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 52.
6*a*, side view.
6*b*, front view.
6*c*, back view.
- 7*a, b.* AMMONITES BRAVAISIANUS; copied from Plate XCI, figs. 3 and 4, of D'Orbigny's 'Paléontologie Française, Terrains Crétacés.' p. 52.
8. AMMONITES BRAVAISIANUS; from the Middle Chalk of Dover; in the collection of S. J. Mackie, Esq.: the specimen has been worn, and the tubercles are nearly all rubbed off, p. 52.
9. AMMONITES BRAVAISIANUS; from the Middle Chalk of Dover; in the collection of J. W. Flower: restored by the artist from a broken specimen, p. 52.
- 10*a, b, c.* AMMONITES WILTONENSIS; from the Grey Chalk, near Devizes, Wiltshire; in the collection of W. Cunningham, Esq., of Devizes, p. 53.
10*a*, side view.
10*b*, front view.
10*c*, outline of a septum.
- 11*a, b, c, d, e.* AMMONITES JUKESII; from the hard Chalk of the county of Londonderry; in the Museum of Practical Geology, p. 53.
11*a*, side view of a fragment, with part of three whorls.
11*b*, side view of the two inner whorls of 11*a*.
11*c*, back view of 11*b*.
11*d*, section of the whorls restored.
11*e*, part of the outline of a septum.

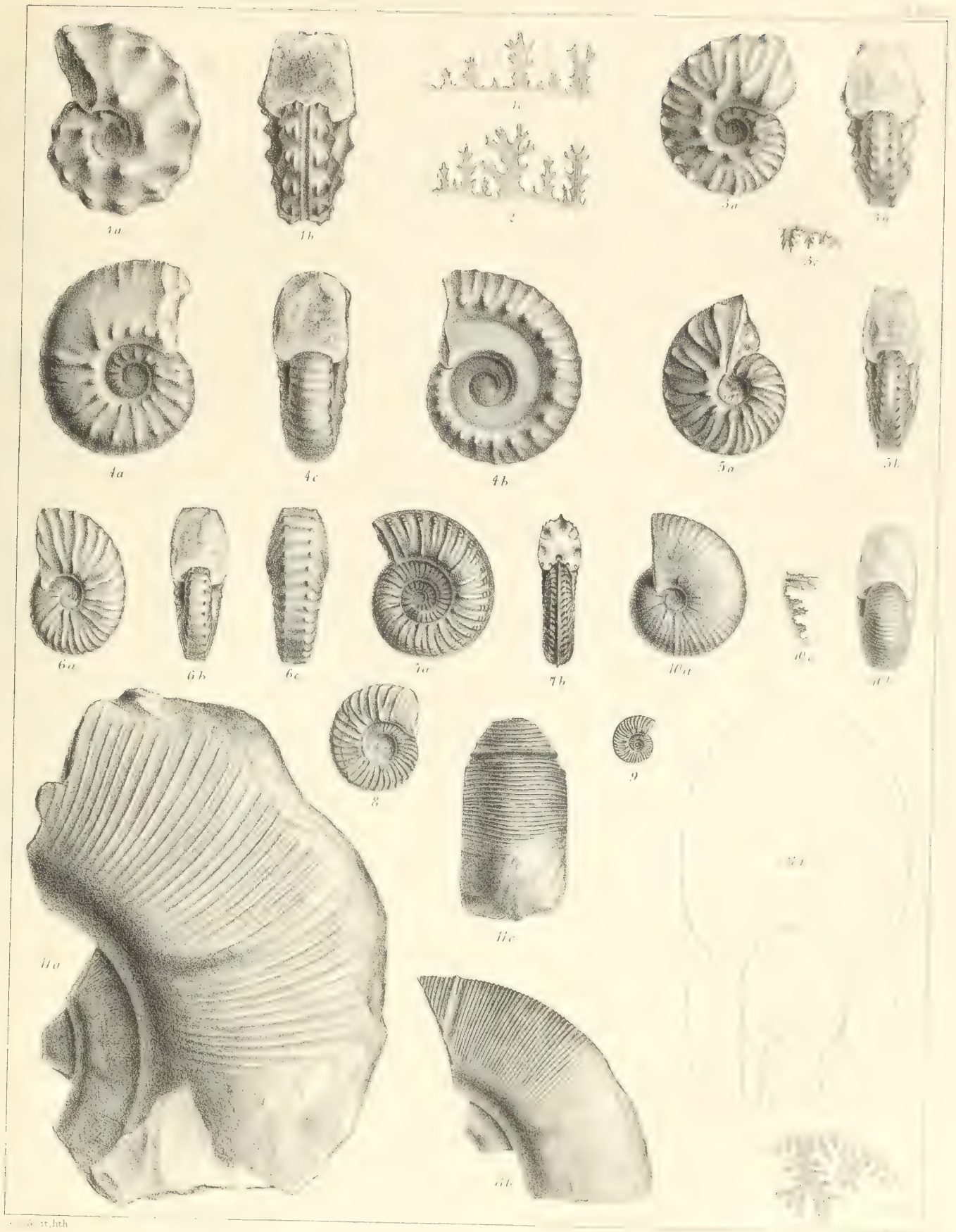


PLATE XXIV.

Fig.

1*a, b.* *APTYPHUS LEPTOPHYLLUS*; from the Upper Chalk of Brighton; in Mr. Sharpe's collection (Geol. Soc.), p. 55.

1*a*, concave (internal) surface.

1*b*, smooth, convex surface.

2, 3, 4. *APTYPHUS PORTLOCKII*; from the Upper Chalk of Norwich; 2 and 3 in the collection of Mr. Bayfield; 4 in the British Museum, p. 56.

5. *APTYPHUS GOLLEVILLENSIS*; Upper Chalk, Norwich; in the collection of Mr. Bayfield, p. 56.

6. *APTYPHUS PORTLOCKII*? p. 56.

7. *APTYPHUS ICENICUS*; Upper Chalk, Norwich; Mr. Bayfield, p. 57.

8*a, b*, and 9. *APTYPHUS RUGOSUS*; Upper Chalk, Norwich, p. 57.

8*a*, external, sculptured surface of a pair of valves; in the collection of Mr. Bayfield, p. 57.

8*b*, internal surface, showing lines of growth.

9, external surface of a large valve, in the collection of Mr. John King, of Norwich, p. 57.

10*a, b.* *APTYPHUS PERAMPLUS*; Upper Chalk, Norwich; Mr. Bayfield, p. 58.

10*a*. internal, striated surface.

10*b*, external surface of a fragment.

11. Outline of the aperture of *AMMONITES ICENICUS*.

12. ,, ,, *A. PORTLOCKII*.

13. ,, ,, *A. LEPTOPHYLLUS*.

14. ,, ,, *A. PERAMPLUS*.

15. ,, ,, *A. GOLLEVILLENSIS*.

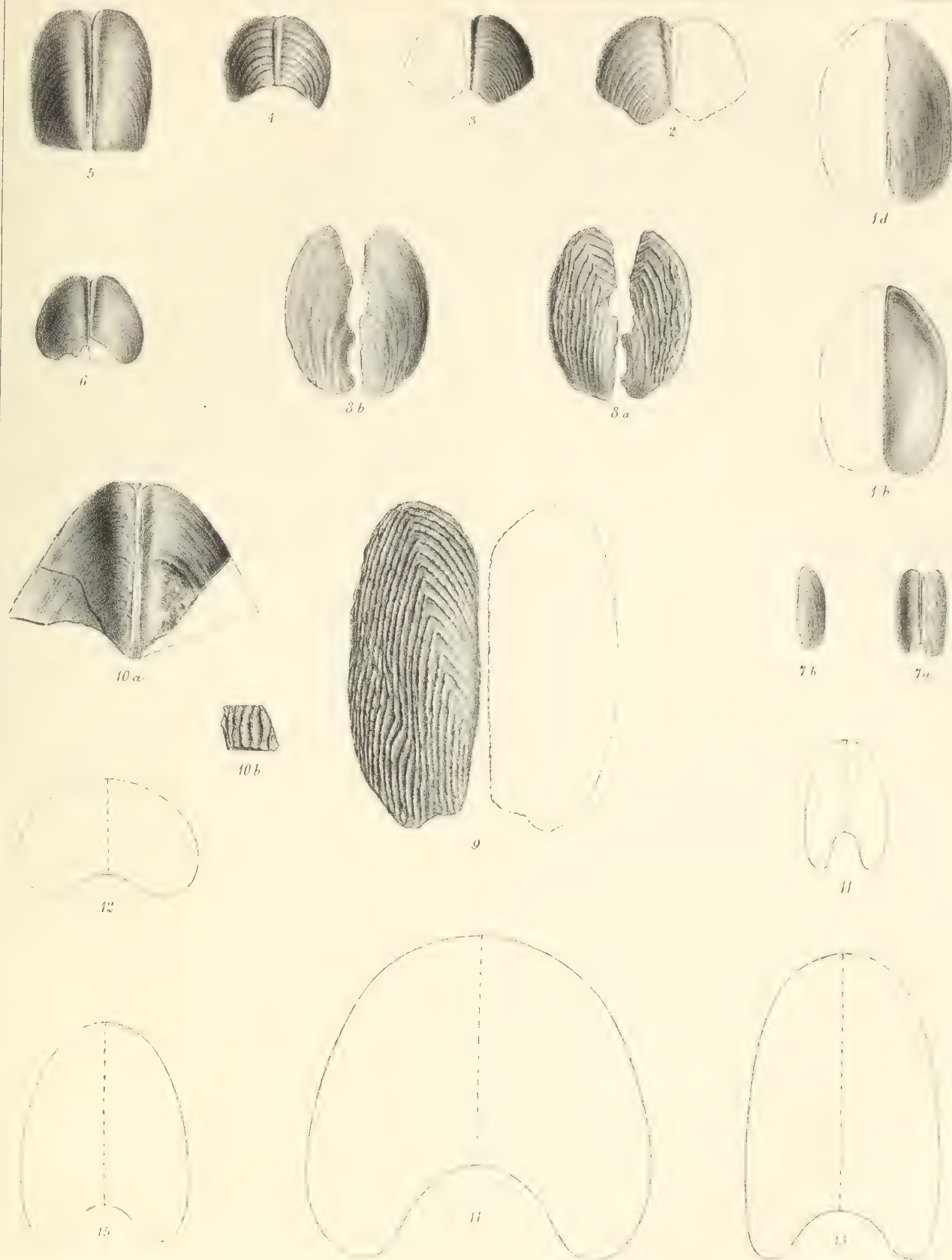


PLATE XXV.

Fig.

1. *TURRILITES TUBERCULATUS*; from the Grey Chalk of Ringmer, Sussex; in the British Museum, from the collection of Dr. Mantell, p. 61.
2. *TURRILITES TUBERCULATUS*, showing the produced mouth; from the Grey Chalk, near Lewes; in the British Museum, from the collection of Dr. Mantell, p. 61.
3. *TURRILITES TUBERCULATUS*; a fragment, showing the position of the lobes of a septum on the outer side of a whorl; from the Grey Chalk of Ventnor, Isle of Wight, in my possession, p. 61.
4. *TURRILITES TUBERCULATUS*; a young specimen, from the Grey Chalk of Ventnor, Isle of Wight; in the collection of S. Saxby, jun., Esq., p. 61.
5. *TURRILITES MANTELLI*; from the Grey Chalk, near Lewes; part of the outline of a septum is shown on the upper whorl; in the British Museum, from the collection of Dr. Mantell, p. 63.
- 6*a, b.* *TURRILITES MANTELLI*; from the Grey Chalk, near Lewes; an adult individual, showing the produced mouth; in the British Museum, from the collection of Dr. Mantell, p. 63.
- 7*a, b.* *TURRILITES GRAVESIANUS*; from the Grey Chalk, near Lewes; the position of the lobes of a septum is shown on the lower whorl of fig. 7*a*; in the British Museum, from the collection of Dr. Mantell, p. 62.

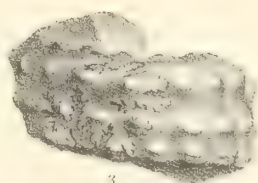
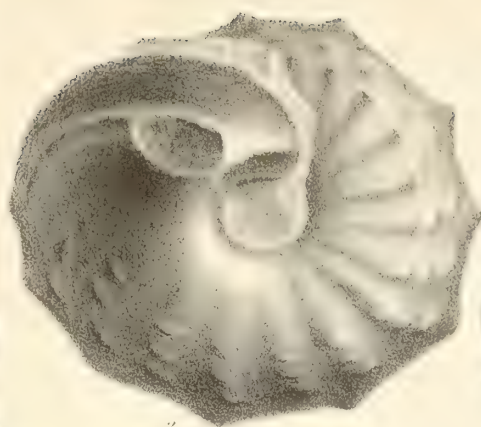


PLATE XXVI.

Fig.

1. *TURRILITES SCHEUCHZERIANUS*; adult, with the mouth produced; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 64.
2. *TURRILITES SCHEUCHZERIANUS*; a young shell, on which part of the produced mouth is preserved; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 64.
3. *TURRILITES SCHEUCHZERIANUS*? a very young shell, with the produced mouth completely formed; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 64.
- 4, 5*a*, *b*, 6, 7*a*, *b*, and 8. *TURRILITES MORRISII*; five specimens of different ages; from the Chloritic Marl of Ventnor, Isle of Wight; in my possession, p. 65.
5*b*, shows the base of the whorl of 5*a*.
7*b*, is the outline of the septum of 7*a*.
9. *TURRILITES BERGERI*; a fragment, showing part of the outline of a septum; from the Chloritic Marl of Ventnor, Isle of Wight; in my possession, p. 65.
10. *TURRILITES BERGERI*; a fragment, from the Grey Chalk, near Lewes; in the British Museum, from the collection of Dr. Mantell, p. 65.
11. *TURRILITES BERGERI*; fragment of a young shell; from the Chalk with siliceous grains, Chardstock, Somersetshire; in the collection of J. Morris, Esq., p. 65.
- 12, *a*, *b*. *TURRILITES*, species undetermined; the last whorl of an adult shell, with the mouth produced; from the Grey Chalk of Lewes; in the British Museum, from the collection of Dr. Mantell.
- 13*a*, *b*. *TURRILITES BECHEI*; from the Chalk with siliceous grains, near Lyme Regis; part of the outline of a septum is seen on the second whorl; presented to the British Museum by the late Sir H. T. de la Beche, p. 66.
14. *TURRILITES GRAVESIANUS*; outline of part of a septum.
15. *TURRILITES TUBERCULATUS*; outline of part of a septum.
16. *TURRILITES TUBERCULATUS*; outline of part of a septum; from the Chloritic Marl of Bonchurch, Isle of Wight; in the collection of S. Saxby, jun., Esq., p. 61.

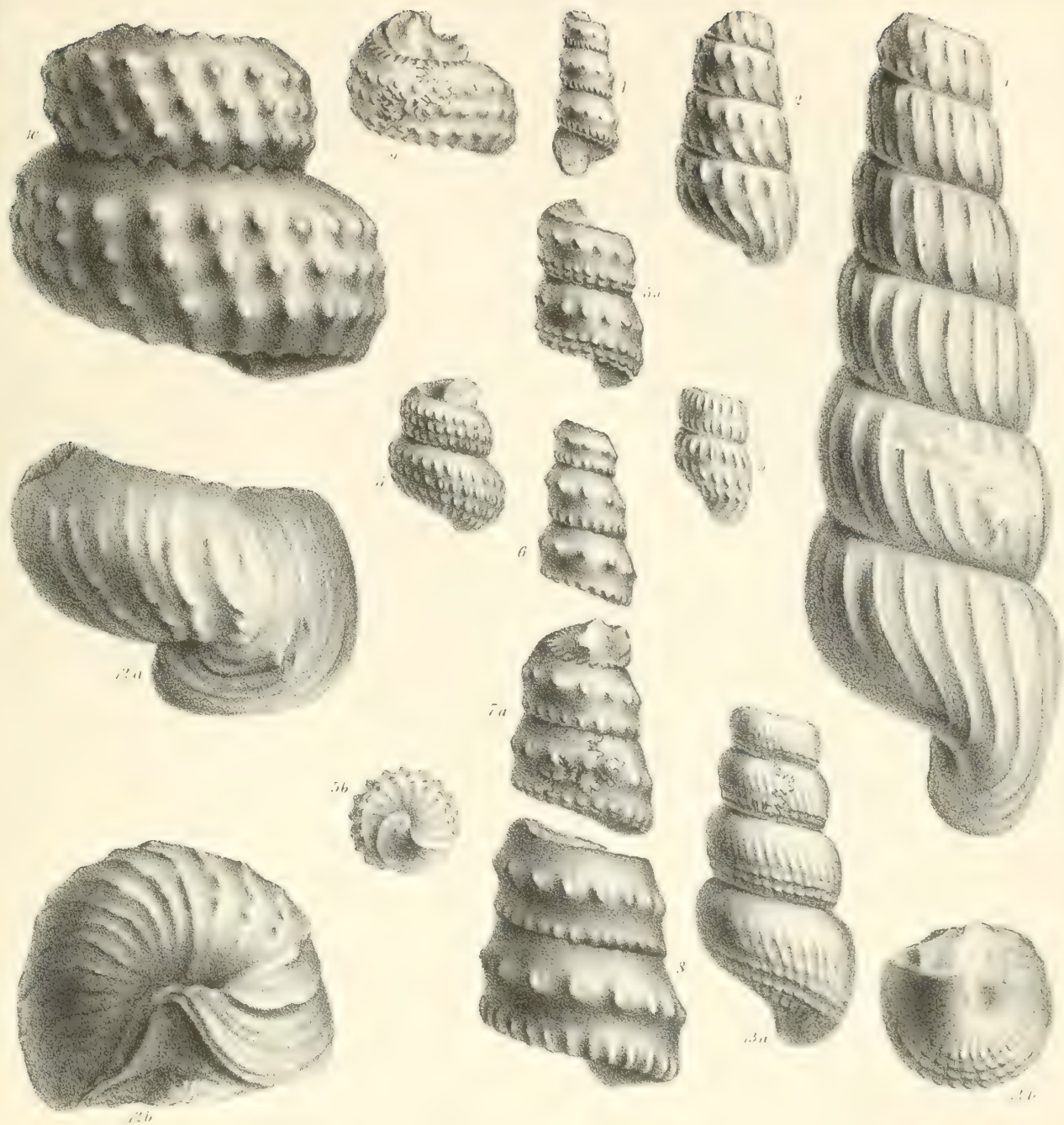
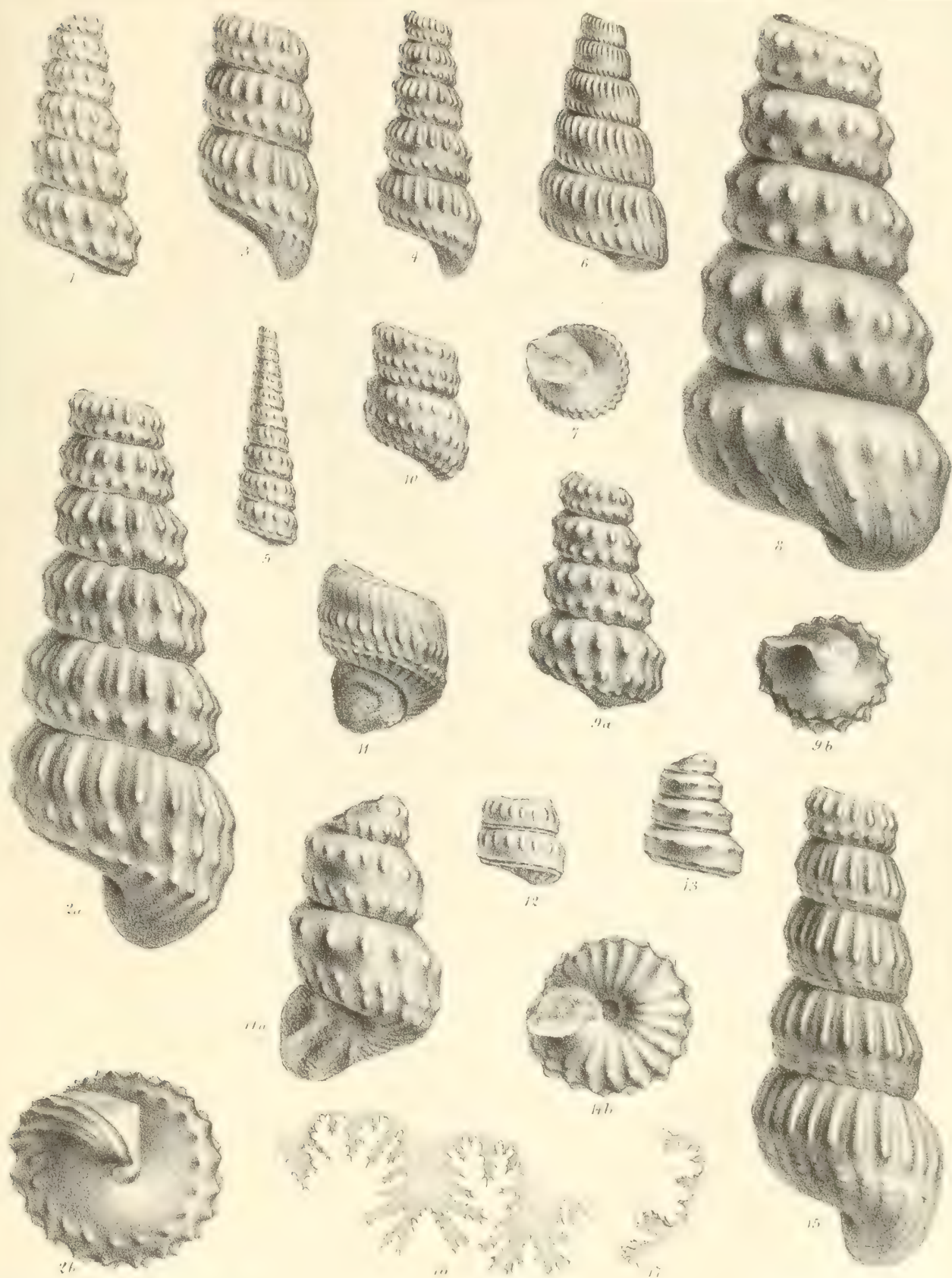


PLATE XXVII.

Fig.

1. *TURRILITES COSTATUS*; young, from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 66.
- 2*a, b.* *TURRILITES COSTATUS*; adult, with the mouth completely formed; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 66.
 2*a*, side view.
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- 3 and 4. *TURRILITES COSTATUS*; two small specimens which have already formed the produced mouth; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 66.
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- 6 and 7. *TURRILITES BIFRONS*? *D'Orb.*; from the Lower Chalk, Ventnor, p. 67.
8. *TURRILITES WIESTII*; from the Grey Chalk of Ventnor, Isle of Wight; in my possession, p. 67.
- 9*a, b.* *TURRILITES WIESTII*; young, from the Chalk with siliceous grains, Chardstock, Somersetshire; in the collection of Mr. John Morris, p. 67.
 9*a*, side view.
 9*b*, base of a whorl.
10. *TURRILITES BERGERI*? *var.*; from the Chloritic Marl of Bonchurch, Isle of Wight. (*Mr. Saxby.*)
11. *TURRILITES PUZOSIANUS*, *D'Orb. var.*; from the Chloritic Marl of Bonchurch, p. 68.
12. *TURRILITES COSTATUS, var.*; from the Lower Chalk of Ventnor, Isle of Wight.
13. *TURRILITES TUBERCULATUS, var.*; from the Lower Chalk of Ventnor.
 These two figures (12, 13) are doubtfully referred to the above species, and may hereafter prove to be distinct: the specimens are only fragments, and in an imperfect state of preservation.
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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLVI.

A MONOGRAPH
OF THE
TERTIARY ENTOMOSTRACA
OF
ENGLAND.

BY
T. RUPERT JONES, F.G.S.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
1856.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

INTRODUCTION.

THE TERTIARY ENTOMOSTRACA of Britain have hitherto received but little notice. In my 'Monograph of the Cretaceous Entomostraca,' 1849, published by the Palæontographical Society, I referred to the occurrence of some of the Cretaceous species in our Tertiary deposits.¹ Dr. Reuss, about the same time, figured and described two forms which he had received from the Barton Clay of Hampshire; and I have since described a few species from Woolwich and Colwell.² Several of the Post-tertiary fresh-water Entomostraca, however, have been noticed by me, in 1850, in the 'Annals of Natural History.' To these latter species I have now to add two others; and of the Tertiary Entomostraca I am enabled, from my own collection and with the aid of my friends, to enumerate 50 species; altogether amounting to 58 species. Of these, 30 (including three described by me in the 'Memoirs of the Geological Survey' whilst preparing this Monograph) are new.

The Post-tertiary species are included in this Monograph for the sake of convenience, and to render the subject as perfect as circumstances will permit. The recent forms which have become fossilized in the Post-tertiary deposits, either of fresh-water, estuarine, or marine origin, not only complete the geological series up to the present day, but are of considerable value in assisting us in the identification of some carapace-remains, otherwise obscure in their relations. The list of these later species of Ostracoda may be also regarded as a not uninteresting addition to the valuable *résumé* of the Molluscan fauna of the Post-tertiary and Pleistocene eras, with which Mr. S. V. Wood has enriched his elaborate and valuable 'Monograph on the Mollusca of the Crag.'

¹ In a few instances the determination of the species or of the deposits has since appeared to me to be unsatisfactory: the localities, therefore, given in the present Monograph are to be considered as corrected in such cases.

² With respect to the Colwell species which were inadvertently quoted as from Woolwich, see further on, p. 26.

With regard to the sources from whence I have derived the materials for the present Monograph, I have first to acknowledge the value of Mr. S. V. Wood's extensive series of Entomostraca from the Crag of Suffolk (chiefly from Sutton), which he most liberally confided to my care for description.

Mr. F. Edwards also kindly placed his numerous specimens from Barton, High Cliff, Colwell, and Bracklesham in my hands; Mr. H. C. Sorby supplied the Bridlington specimens; and I have the pleasure of noticing in the Monograph my debts to Mr. Brown, Mr. Pickering, Mr. Harris, Mr. Wetherell, Mr. Parker, Mr. Prestwich, and other friends for like assistance.

The London Clay specimens were chiefly collected by Mr. J. Purdue from the Copenhagen Fields.

To Mr. Morris and Mr. Salter I am especially obliged for the opportunity of examining an extensive series of "Cypris-shales" from the Hempstead and the Osborne Series of the Isle of Wight, chiefly collected by the officers of the Geological Survey, and some by Mr. Morris himself. Previously I possessed but a limited supply of these shales; but the new materials, though too late for illustration in the plates of this Monograph, enabled me to determine one additional species, and to add to my descriptions of some others.

The specimens at my command from several of the localities referred to in the Monograph represent tolerably well the Entomostracan fauna of the deposits yielding them. The following may be considered as more or less fully illustrated, viz. the Newbury peat-beds (indifferently), the Cambridgeshire peat-marl, the Copford freshwater deposits (indifferently), the Pleistocene beds at Grays, Clacton (indifferently), and Wear Farm, the Crag of Sutton, the Upper Eocene shales of Hempstead Cliff, the Middle Eocene beds at Colwell, Barton, and Bracklesham, and the London Clay at Copenhagen Fields.

The distribution of the Tertiary Ostracoda and their proportional occurrence are generally indicated in the text; but the synoptical tables of the distribution and relative abundance of the species, given in the Appendix (Tables I, II, III), will, it is hoped, materially assist the student and collector in this respect.

Frequently a deposit has been too imperfectly worked for a sufficiently good result for the purposes of comparison to have been obtained,—such as at Edwardstone, Alum Bay, East Woodhay, &c. Still the Post-tertiary era and each of the divisions of the Tertiary formation are perhaps, as far as the South East of England is concerned, fully represented by the combined product of the several localities where the different deposits have been met with.

In indicating the geological series to which the several deposits both in England and on the Continent belong, I have chiefly followed the valuable Table at p. 105, of Lyell's 'Manual of Elementary Geology,' 5th edition.

M. Bosquet's elaborate Table¹ of the distribution of the French and Belgian species refers to the Upper, Middle, and Lower Tertiaries of those countries respectively; but, as the "Lower Tertiaries" therein indicated do not necessarily include the *Lower Eocene*, which is but sparingly exhibited in France, it has been requisite, for the sake of comparison, to work out the serial position of the several deposits in which the species of Ostracoda found in England occur also on the Continent; and the result is given in Table IV in the Appendix.

Tables V and VI in the Appendix will assist the reader in remembering the relations of the English and the Continental Tertiary deposits. Table VI comprises some of the latest corrections introduced by Mr. Prestwich, to whom geologists are greatly indebted for important information on the correlation of the Tertiaries of England, France, and Belgium.

I have prefaced the descriptive portion of the Monograph with as complete a general notice of the zoological characters of the animals whose carapaces are under consideration, as the means and time at my disposal have allowed me to do. I regret that the minute anatomical research is almost denied to me now by impaired eyesight: nor have I been enabled, for the same reason, to fully examine the "lucid spots" in the carapaces, as I once intended.

In a zoological point of view, the species about to be described offer us some interesting peculiarities in the structure of the carapaces and in their hingement and ornamentation. Geologically, it is interesting to observe that considerable uniformity in the distribution of certain species, and of groups of closely allied species, obtain in England and the neighbouring European districts. Several forms belong exclusively to the Middle Eocene, and some are confined to the Lower Eocene, or to other stratigraphical series. On the contrary, some species belong to several deposits of different ages, and of wide geographical range,—such as *Cythere (Cytheridea) Mulleri* and *C. (Bairdia) subdeltoidea*, which latter is found from the Cretaceous to the recent period.

I sincerely thank Mr. George West for the beautiful illustrations he has produced of these remains;—often obscure and always minute, they have taxed his skill and patience; and I owe him much, too, in the elucidation of many points of structure which would have been indifferently noticed had he not, with the eye of a naturalist and geologist, worked out obscure characters at the expense of much time and labour.

In figuring the specimens I have placed the carapaces and single valves with the anterior end upwards; this being the most convenient, when carapace-remains only have to be represented. It has therefore to be borne in mind that the upper and lower borders of the carapace-valves are right and left in the figures.

¹ 'Descript. Entom. Terr. Tert.,' p. 134, &c.

The natural position of the carapace and animal, when alive, is shown in the woodcuts 1 and 2, at p. 16.

M. Reuss's plan of placing the anterior end downwards is rather confusing; more especially since others follow a different plan.

In the Plates the species are arranged, with some few exceptions,¹ in stratigraphical order; so that the general *facies* of each geological group is represented with tolerable clearness.

NOVEMBER, 1856.

¹ Especially of the Woolwich Series.

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ERRATA.

Page 5, line 2 from bottom, *for* cleanse *read* cleansed.

Page 15, line 3 from top, *for* 13—17 *read* 13, 14, 17.

Page 17, line 16 from top, *for* Candona lucens *read* Candona candida.

Page 30, line 18 from top, *for* Pleistocene *read* Pliocene.

Page 33, line 5 from top, *for* laticostata *read* Laticosta.

Page 47, line 10 from bottom, *for* Pleistocene *read* Pliocene.

Page 49, line 7 from bottom, *for* Upper Eocene *read* Middle Eocene.

Page 50, line 2 from top, and line 10 from bottom, *for* Upper Eocene *read* Middle Eocene.

Page 51, line 3 from top, *for* Upper Eocene Lands *read* Middle Eocene Sands.

Page 58, in the last column but one, and towards the lower right-hand corner of the table, some lines of letters have slipped from their places: their right position is thus—

| | | |
|--------|-----------|---|
| M. E. | M. E. | |
| Plioc. | M. E. | |
| Plioc. | | |
| Plioc. | | |
| Plioc. | | |
| Plioc. | | |
| L. E. | | |
| M. E. | { U. E. ? | |
| | & M. E. | |
| Plioc. | { U. E. & | |
| | M. E. | |
| M. E. | M. E. | * |
| L. E. | | |

ADDITIONAL ERRATA.

In Tables II and III, "Colwell Bay" should be tabulated as UPPER EOCENE. The numerical results given at the foot of Table III will consequently be—

| | | | | | | | | | | | | | | | | | | | | | |
|---------------|--|----|--|----|--|----|--|---|--|---|--|---|--|---|--|----|--|---|--|----|--|
| Upper Eocene | | .. | | 1 | | .. | | 3 | | 1 | | 3 | | 4 | | .. | | 1 | | 12 | |
| Middle Eocene | | .. | | .. | | .. | | 8 | | 2 | | 2 | | 1 | | 2 | | 2 | | 17 | |

At pages 26, 33, 34, and 39, the Colwell Bay Sands, &c. have been wrongly termed *Middle Eocene*. At page 49, near the bottom of page 50, and at page 51, they are correctly referred to as *Upper Eocene*.

Besides the accidental shifting of the letters at the bottom of the nineteenth column in Table II, p. 58, the letters in that column opposite to species 18 and 19 have also dropped too low.

A MONOGRAPH
OF THE
TERTIARY ENTOMOSTRACA OF ENGLAND.

IN the introductory portion of my 'Monograph of the Entomostraca of the Cretaceous Formation of England,' published by the Palæontographical Society, 1849, and also in my Notes on the Permian Entomostraca, at p. 58 of Professor King's Monograph, of the same date, I offered some general remarks on fossil and recent Entomostraca, and supplied numerous references to earlier observers who had written on the subject.¹

I need not repeat what is there stated. Since 1849 some highly important works on the recent Entomostraca by Baird, Dana, Liljeborg, Zenker, Fischer, &c., have appeared;² and numerous valuable papers, illustrative of the fossil forms, have been published by foreign Academies and Institutions. Amongst these palæontographical works, the two Memoirs by M. J. Bosquet, of Maestricht, on Tertiary and Cretaceous Entomostraca, are pre-eminent; and, at the same time, Dr. A. E. Reuss, of Prague, has indefatigably produced several valuable and highly illustrated Memoirs, some of considerable extent, on similar fossils.

I do not propose to enter into a critical examination of the Tertiary species described by these and other contemporary authors, for the figures published by some of these writers are, either from their indefiniteness or the want of the illustration of details, of little use, even with the aid of the descriptions given, in satisfactorily determining the differences or the specific identity of specimens;³ and I greatly regret that I trusted too much to the illustrations of former authors, when I was comparing

¹ See also Bibliographical List, 'Monog. Ent. Cret.,' p. 38. ² See Bibliographical List, APPENDIX.

³ Owing to the kindness of M. Bosquet, however, who has furnished me with a series of the Cretaceous and Tertiary Entomostraca of Belgium and France, I have been enabled to compare many of the forms described in this Monograph with their European congeners.

the English with the foreign Cretaceous Entomostraca. With regard to the generic arrangements adopted in the palæontographical works referred to, I shall only observe that, for the most part, the fossil carapace-valves have been studied and arranged with but an indifferent knowledge of the relations of the carapace and animal. Hence, as soon as the misapplication of the generic term "Cypridina" to the *Cytherinæ* was corrected, the sub-generic divisions of *Bairdia*, *Cytherella*, &c., were erected into independent genera on account of difference of carapace-structure; a reason which does not appear to me to be substantial, but requires other accompanying differences of organization in the animal to render it good for generic distinctions. As far as we yet know, the animal of *Bairdia* resembles that of *Cythere* proper, and so does that of *Cytheridea*, judging from Dana's figure of *Cythere Americana*¹ and Zenker's figure of *C. viridis*.² The animals with the other forms of carapace (*Cythereis*, *Cytherella*, &c.), although they exist, have not yet been met with alive.

If future investigations in the *Cytherinæ* by such close observers as Zenker and Liljeborg should determine the existence of differences in internal organization (as these authors already have in the *Cyprinæ*) among animals which differ but slightly in the character and arrangement of the masticatory and locomotive limbs, the division of *Cythere* into genera will become necessary; but at present, with carapaces only before us, however these may differ among themselves, I think we had better keep the genus intact, and regard the subordinate forms of carapace (which often pass insensibly from one to another) as indicating only sub-genera or artificial divisions, convenient in the studies of zoologists and palæontologists.

By pointing out, in my former Monograph, how frequently one and the same form of carapace among the *Ostracoda* was represented in different eras—in strata greatly differing in age, or in recent seas as well as even sometimes in palæozoic deposits—I have so much astonished some Continental palæontologists (who have found it necessary to point out that I have mixed together what they regard as "incongruities," both geological and palæontological),³ that I shall abstain from troubling myself with enumerating all the close resemblances of form, and limit myself to the most obvious, assuring my readers that these incongruities do exist, and that very similar forms of carapace, both in the *Ostracoda* and in other *Entomostraca*, occur throughout nearly all epochs; although each geologic division of time has nevertheless had its peculiar *facies* as regards the Entomostraca, as it has had of other groups of animal existences.

¹ Dana's 'Crustacea,' pl. 89, fig. 9.

² 'Archiv f. Nat.,' 1854, t. 4, fig. 10, &c.

³ Pictet 'Traité de Paléontologie,' 2d edit., vol. ii, p. 532; Reuss, 'Zeitsch. Deutsch. Geol. Ges.,' vol. vii, p. 278.

*Division—ENTOMOSTRACA, Müller.*¹

Animal aquatic, covered with a shell or carapace of a horny consistence, formed of one or more pieces; in some genera resembling a cuirass or buckler, and in others a bivalve shell, which completely or in great part envelopes the body and limbs of the animal; in other genera the animal is invested with a multivalve carapace, like jointed plate-armour: the branchiæ are attached either to the feet or to the organs of mastication; the limbs are jointed, and more or less setiferous. The animals, for the most part, undergo a regular moulting or change of shell as they grow; in some cases this amounts to a species of transformation.²

The following is Mr. Dana's classification of this division:

Division—ENTOMOSTRACA.

| | |
|--------------------------------|-------------------------------|
| <i>Order 1. Gnathostomata.</i> | <i>Order 2. Cormostomata.</i> |
| <i>Legion I. Lophypoda.</i> | <i>Legion I. Pœcilopoda.</i> |
| <i>Tribe 1. Cyclopoidea.</i> | ,, <i>II. Arachnopoda.</i> |
| ,, 2. Daphnioidea. | |
| ,, 3. Cyproidea. | |
| <i>Legion II. Phyllopoda.</i> | |

I have elsewhere observed that, in the case of the fossil Entomostraca, the soft parts, including the branchial, maxillary, and locomotive organs, on which the generic, and sometimes the specific, distinctions of the recent forms are mainly established, have quite disappeared, the hard carapace-valves alone remaining to guide us in the recognition of genera and species. It is fortunate, however, that the families, and most of the genera even, of the existing bivalved Entomostracans have carapaces sufficiently characteristic to enable us to co-ordinate the fossil forms by the analogies presented in the form and structure of the valves. When we refer, however, to the *minute distinctions of form, hingement, and ornamentation*, we find that among the recent bivalved Entomostraca some families, and even genera, have carapaces peculiar to them (*Nebalia*, *Limnadia*, and *Cypridina*); whilst in other families a nearly similar carapace belongs to two genera (*Cypris* and *Candona*, *Daphnia* and *Lynceus*); and, on the contrary, even two characteristically different carapaces occur among the species of one genus (*Cythere* and its sub-genus *Bairdia*).

In the case of two or more genera presenting a similar form of carapace, we

¹ For synonyms see Dr. Baird's 'Nat. Hist. Brit. Entom.,' p. 16.

² Zenker observes that there is no casting of the carapace in the Ostracoda.

necessarily meet with considerable difficulty in dealing with fossil carapaces referable to such genera. Thus we cannot be satisfactorily guided in our determination of fossil *Cyprides* and *Candonæ* except by the identification of fossil with known recent forms of carapace; and, were it not that several such identifications are readily made (many of the recent species having existed in the pleistocene period), the general term "Cypris" might have been conveniently applied (with but little zoological licence, owing to the close alliance of *Cypris* and *Candona*) to the Cypris-like carapaces from fresh-water deposits. Where, however, marked differences of structure occur among fossil carapaces of doubtful relationship, we may readily, for the sake of convenience, group the several varieties of form under sub-generic appellations, without hazarding a decision as to their exact zoological value.

*Tribe—OSTRACODA, Latreille.*¹

CYPROIDES, *Milne Edwards.*

CYPRIDACEA, *Dana.*

CYPROIDEA, *Dana.*

Animal enclosed in a bivalved carapace (which presents some modifications of form and structure according to the gender of the animal). The two valves of the carapace are united along the back by a membrane, with their edges either simply in contact, or more or less closely fitting to each other by means of ridges and furrows, or toothed hinges: the other marginal edges are either trenchant and provided with internal narrow lamelliform plates—in which case, when the valves are closed, the edges of the smaller valve lie within those of the other; or they are thickened, and fit against each other with grooved and flanged contact-surfaces. The valves are closed together by the transverse muscle of the animal; the place of the attachment of this muscle² is indicated on the interior of each valve by a sub-central tubercle (in *Cytherella*),—by a sub-central shallow pit,—or by a small group of translucent spots,—or a combination of spots and pit. The posterior, and sometimes the anterior jaws are branchiferous. There are two or three pairs of feet, and two pairs of antennæ. Some of the *Ostracoda* have a single (coalesced) eye; and others have two distinct eyes.

¹ See also 'Nat. Hist. Brit. Entom.,' p. 138; and 'Monog. Cret. Entom.,' p. 7.

² We are indebted to M. Zenker for a clear exposition of the relation of the transverse muscle of the animal to the "lucid spots" on the carapace-valves. See his Memoir in the 'Archiv für Naturgeschichte,' for 1854. The existence of the muscle and its place of attachment to the interior of the valves in *Estheria* and *Cypridina* have been pointed out elsewhere, as mentioned in my paper on *Leperditia*, 'Annals and Mag. Nat. Hist.,' Feb. 1856, p. 97. I much regret that I was not acquainted with M. Zenker's paper when I wrote on *Leperditia*.

The "lucid spots," or mark of the place of muscular attachment, afford an interesting subject for examination and comparison. It is generally impossible to see them fairly in the living carapace or in the uncleaned dead valves. Some fossil valves present them clearly; but mineralization frequently obscures them. To facilitate the examination of the spots, it is necessary to boil the valves, both recent and fossil, in a weak solution of potash,¹ after which their structure is much more easily observed. The boiling may be carried on in a flask over a spirit- or gas-lamp for ten minutes or more,—as long as an hour, if found requisite. My friend Mr. W. K. Parker, who has kindly favoured me with some of the finest and cleanest specimens in my collection, informs me that the process above mentioned is appropriate and indeed necessary for the preparation of *Foraminifera* and other microzoa for the cabinet.

Baird, Fischer, Zenker, and Liljeborg have indicated the lucid spots in their figures of *Cyprides* and *Cytheres*; but frequently, owing to the partial opacity of the valves in the recent state, and the difficulty of defining the spots externally, only portions of the groups of spots are given; and in some of the figures by Fischer and Liljeborg the spots appear to have been sketched in without exact reference to their position on the valve, since they are in these instances represented parallel with the upper and lower borders of the valves, whereas the elongate spots are, as a rule, obliquely situated.

The lucid spots occupy a sub-oval space, or follow a short transverse linear sulcus, near the middle of each valve, and rather towards the ventral border; usually slightly in advance of the centre, but sometimes behind it. The sub-oval space is sometimes faintly raised externally; the spots themselves, however, are almost always concave externally and convex internally.

Among the *Cyprinæ* three styles or systems of arrangement of the spots obtain. These are illustrated by some of the figures in the accompanying Plates, and will serve as terms of comparison.

A. A system of about seven elongate oval spots, arranged in four unequal parallel oblique rows; the two outer (upper and lower) rows are each formed of two long spots, frequently coalescent. The obliquity is directed in a line from about the antero-dorsal angle, or the anterior hinge, towards the posterior third of the ventral margin. (See Plate I, figs. 7 *a*, 7 *b*, 7 *c*, 9 *a*.)

B. A system of six sub-oval spots arranged in two transverse (vertical) rows; the front row consisting of four, and the hinder row of two spots; the hinder spots are

¹ About 1 part of *liquor potassæ* with 19 parts of water (and more of the potash if required, according to the coarseness and foulness of the specimens, up to 1 part in 4).

My friend Mr. Harris, of Charing, also has shown me some of his Cretaceous Entomostraca, &c., thoroughly cleanse by the action of water only, in a phial, half-filled with water, lashed to a small barrel (externally fitted as a water-wheel, and propelled by a stream), in which he washes his Chalk-detritus.

usually placed behind the lower or most ventral spots of the front rank. (See Plate I, figs. 1 *a*, 1 *b*, 1 *c*, 5 *b*, 8 *a*, 8 *e*, 8 *f*.)

c. A system of four or five sub-oval spots, arranged in a transverse row, more or less curved, and set in a linear sulcus. (See Plate II, figs. 1 *a*, 1 *e*, 1 *f*; Plate IV, fig. 6 *d*.)

The lucid spots in the *Cytherinæ* are not yet well examined. In some species they are very similar to one or other of the systems above described as occurring among the *Cyprinæ*,—in others the modifications are more distinct,—and, lastly, in *Cytherella* the arrangement of the spots resembles that of some *Cypridinæ*.

The following is Mr. Dana's classification¹ of the *Ostracoda* (*Cypridacea* and *Cyproidea*, Dana), founded on the study of the limbs or articulate appendages :

Tribe—CYPROIDEA vel OSTRACODA.²

In the *Cyproidea* there are two pairs of antennæ and a pair of mandibles, and the pairs of appendages posterior to the mandibles—in number four pairs—are divided variously between the mouth and the legs, as follows :

1. One pair of maxillæ and three pairs of legs, as in *Cythere*.
2. Two pairs of maxillæ and two pairs of legs, as in *Cypris*, *Conchæcia*, and *Halocypris*.
3. Three pairs of maxillæ and one pair of legs, as in *Cypridina*.

Fam. I. CYPRIDÆ. *Antennæ secundæ subteretes, 3—5 articulatæ. Mandibulæ apice productæ et denticulatæ et lateraliter palpigeræ, palpo ad mandibulæ apicem remoto. Oculi pigmento unico minuto conjuncti, lenticulis duobus sphericis. Pedes duo vel plures tenuiter pediformes.*

Sub-fam. 1. CYPRINÆ (Cyprididæ, Baird). *Pedes numero quatuor; anteriores tenues pediformes, posteriores debiles. Abdomen elongatum stylis duobus confectum.*

Genus 1. CYPRIS, Müller. *Antennæ secundæ ad articuli tertii apicem bene setigeræ. Species natatoriæ.*

Genus 2. CANDONA, Baird. *Antennæ secundæ ad articuli tertii apicem vix setigeræ. Species gressoriæ.*

¹ 'Exploring Expedition: Crustacea,' p. 1277, &c.

² Dr. Baird's classification of this group is very similar to Dana's, viz.:

OSTRACODA.

Cyprididæ, Cytheridæ, Cypridinadæ.

In Dr. Baird's work the term "Cypridæ" is corrected as an *erratum* at p. viii.

Sub-fam. 2. CYTHERINÆ (Cytheridæ, Baird). Pedes numero sex, toti tenues, con-
similes, pediformes.

Genus 1. CYTHERE, Müller. Testa tenuis, lævis. Cauda brevis.

Genus 2. CYTHEREIS,¹ Jones. [Sub-genus, Jones.] Testa rugulis vel tuberculis
ornata. (Animal ignotum. An hujus sedis?)

Fam. II. HALOCYPRIDÆ.

Sub-fam. 1. CYPRIDININÆ.

Genus 1. CYPRIDINA.²

Sub-fam. 2. HALOCYPRINÆ.

Genus 1. CONCHÆCIA.

Genus 2. HALOCYPRIS.

The minute anatomy of the internal organs supplies some very important characteristics in addition to those derived from the limbs. Zenker, who has published³ copious anatomical details of the internal organization of some of the *Cyprinæ* and *Cytherinæ*, and has somewhat modified the generic arrangement of the former group, has still other species to examine before a complete classification on his plan can be arrived at. This observer finds reason to divide the *Cypris* of authors into *Cypris* proper, a sub-genus *Cypria*, and a genus *Cyprois*.

The elaborate and highly illustrated work by M. Liljeborg, of Lund, published in 1853, has added greatly to our knowledge of the anatomical structure of a considerable number of species of *Cypris*, as well as of other genera of *Entomostraca*; and, by his careful comparison of the Swedish species with published descriptions (as far as the figures and descriptions of former authors serve), this author has advanced the arrangement of specific forms.

¹ *Cythereis* was not established by me as a *genus*, but as a *sub-genus*. See 'Monog. Entom. Cretac.,' p. 14. Its animal was unknown in 1849, and still remains so; and the gradual passage of the carapace of *Cythereis* into that of *Cythere* proper was too well recognised to allow of the difference of the two forms being dwelt upon in any other light than as sub-generic, and as a convenient distinction for the sake of palæontologists. My friend Dr. Baird, from whose beautiful work on the 'British Entomostraca' (Ray Society, 1850) Dana has apparently derived his information on this point, recognising the marked difference between some extreme forms of recent *Cythereis* and that of the common *Cythere*, figured and described some carapaces of the former as generically distinct, and inadvertently omitted, when enumerating the synonyms (p. 174), the word "sub-genus" in his reference to my detailed description of the carapace of *Cythereis*. On subsequently seeing a series of the various modifications of the carapace in fossil specimens of *Cythere* and *Cythereis*, Dr. Baird has expressed himself quite willing to regard the latter as a sub-genus, until something at least is known of the animal itself.

² M. Liljeborg has also established a cognate genus, *Philomedes*. ('De Crustaceis,' &c., 1853, p. 175.)

³ 'Archiv f. Anat.,' 1850; 'Archiv für Naturgeschichte,' for 1854.

Liljeborg divides the *Cyprinæ* into three genera, characterised as follows :

| | | | | |
|-------------------------|--|---|--|---------------|
| Eye double. | Second pair of maxillæ without branchial appendage. | Lower pair of antennæ provided with a pencil of setæ, or filamentous plume. | Setæ long, reaching much beyond the apex of the terminal hook. | } Notodromas. |
| | Both pairs of maxillæ provided with branchial appendage. | | Setæ reaching as far as or beyond the apex of the terminal hook. | |
| Eye single (coalesced). | Second pair of maxillæ without branchial appendage. | Lower pair of antennæ without a pencil of setæ. | Setæ short. ¹ | } Cypris. |
| | | | | |
| | | | | Candona. |

The researches of Liljeborg and Zenker often coincide in their results ; but these authors differ widely in their views as to the synonymy of several forms, owing to the often imperfect accounts and figures by earlier naturalists,—to the different extent or direction of the zootomical examinations made by these two authors respectively,—and to the different appreciation of the value of the form of the carapace entertained by them.

As it is necessary that the anatomy of all the species must be fully and equally well examined previously to a complete classification on anatomical grounds being made, it is evident that any arrangement is incomplete until each known species has been subjected to such a minute examination as that instituted by the crustaceologists above referred to.

In the meantime palæontologists must be guided in the recognition of specific forms by the characters of the carapace-valves, which, however, among the *Cyprinæ* do not present satisfactory generic differences of character. The carapaces of *Cypris* proper, *Cypria*, and *Notodromas* or *Cyprois* are similar in general structure and form. The carapaces of the *Candonæ*, or the group which are destitute of the plume on the lower antennæ, for the most part resemble those of *Cyprides*, but are conspicuous for their great relative size and oblong shape. A distinct hingement, however, is present in a *Candona*-like species which occurs recent at Gravesend, and fossil in our pleistocene deposits. This animal resembles *Candona* in its plumeless lower antennæ ; but minute anatomical examination is required to determine its exact relations. In the meantime, on account of the hinge and the comparative coarseness of the carapace, I shall regard this as a sub-generic form, under the appellation of *Cyprideis*.

In the 'Munich Transactions,' of 1855, Dr. S. Fischer has given us an additional memoir on the *Ostracoda*, in which he refers to some of Zenker's and his own

¹ These short setæ do not form a *plume*, and characterise forms which are included in Baird's genus *Candona*.

discoveries in the anatomy and habits of these animals, and describes seventeen species of *Cypris*, nearly all of which are new, also three *Cytheres* (two of them new), and a new genus (*Paradoxostoma*), from the coast of Madeira, differing from *Cythere*¹ in having its masticatory organs blended together in a conical mass. Lastly he notices a new species of *Asterope* (= *Cypridina*).

Including the new generic divisions established by Liljeborg and Zenker, together with the sub-genera proposed for the various fossil and recent forms referable to *Cythere*, the family *Cypridæ* will stand thus :

Fam.—CYPRIDÆ, Dana.

| | | | | |
|------------|-------------------------------------|-------------------------|------------|-------------------------------------|
| Sub-family | CYPRINÆ, Dana. | | Sub-family | CYTHERINÆ, Dana. |
| Genus | CYPRIS, Müller. | | Genus | CYTHERE, ⁴ Müller. |
| Sub-genus | CYPRIA, Zenker. | | Sub-genus | CYTHEREIS, Jones. |
| Genus | CYPROIS, Zenker. | } Probably the same. | „ | CYTHERIDEA, ⁵ Bosquet. |
| „ | NOTODROMAS, Liljeborg. | | „ | CYTHERIDEIS, Jones. |
| „ | CANDONA, Baird. | | „ | BAIRDIA, ⁶ M'Coy. |
| <hr/> | | | „ | [?] CYTHERELLA, ⁷ Jones. |
| Sub-gen. | [?] CYPRIDEIS, ² Jones. | | Genus | [?] PARADOXOSTOMA, Fischer. |
| „ | [?] CYPRIDEA, ³ Bosquet. | | | |

I may here mention that *Cyprella* and *Cypridella*, of M. De Koninck, probably belong to a different group of the Entomostraca,—that Bosquet's "Cyprellæ" of the Cretaceous and Tertiary deposits are true *Cypridina*,—and that De Koninck's "Cypridina" (of the Carboniferous Limestone) is not the *Cypridina* of Milne Edwards. In a courteous reply to an inquiry with which I lately troubled M. Milne Edwards, he kindly informed me that the *Cypridina* described in the 'Hist. Nat. des Crust.' has really the antero-ventral notch so characteristic of the genus.

¹ It resembles in carapace *C. variabilis* of Baird.

² Having lately again endeavoured to obtain clearer anatomical characters from the few dried specimens I possess of this form, I find that the upper antennæ are plumeless, as well as the lower pair (see fig. 2, p. 16); and the fragmentary posterior limbs appear to be referable to more than two pairs of feet. Under these circumstances we have indications of a fresh or brackish water *Cythere*. (Oct. 1856.)

³ Proposed by M. Bosquet as a genus for the "Cyprides" of the Wealden and Purbeck deposits ('Descript. Entom. Tert.,' p. 48); their thick and often tuberculated valves have some analogy with those of *Cyprideis*.

⁴ Zenker observes that *Cythere* is perhaps divisible into two genera at least, by the distinctive characters of the spermatozoa; but further anatomical research is required on this point.

⁵ Proposed as a genus by M. Bosquet.

⁶ Proposed as a genus by Mr. M'Coy.

⁷ This division is more likely to prove to be a true "genus," when the recent animal is examined, than either of the other fossil forms here indicated as sub-genera; for it presents a wider departure from the type of carapace of *Cythere* than any of the others, and intermediate forms appear to be wanting: in its system of "lucid spots" also it differs from *Cythere*; approaching *Cypridina* in this respect.

For the purposes of the palæontologist a succinct table of the characters of the carapace of the chief forms of the *Ostracoda* will be useful:

| CARAPACE-VALVES. | | | | | | |
|------------------------|-----------|-----------------------------|--|---|---------------------------------|--|
| | | Shape. | Contact-margins. | | Hinge-margins. | |
| CYPRIS, genus | Thin. | Ovate or oblong. | Bevelled off inside, and lined with a more or less developed narrow laminar plate, which is largest in <i>Cypris</i> , <i>Candona</i> , and <i>Bairdia</i> . | | Simple, inclined to be sulcate. | |
| CANDONA, genus | Thin. | Long-ovate or oblong. | | Larger than <i>Cypris</i> . | | |
| CYPRIDEIS, sub-gen. ? | Thickish. | Oblong. | | Notched at the antero-ventral angle. | | Knurled. |
| CYPRIDEA, sub-gen. ? | Thick. | | | | | |
| CYTHERE, genus | Thickish. | Ovate. Oblong. | | Peach-stone-shaped. Often showing one central and two posterior tubercles. The three tubercles strongly shown; the postero-ventral one developed into a long ventral ridge. | | Hinge consisting of bar and furrow, with terminal teeth. |
| CYTHEREIS, sub-gen. | Thick. | | | | | |
| CYTHERIDEA, sub-gen. | Thickish. | Triangular or ovate-oblong. | | | | Knurled. |
| CYTHERIDEIS, sub-gen. | Thin. | | | | | |
| BAIRDIA, sub-gen. | Thin. | Triangular. | | Grooved and furrowed. | | Simple and sulcate, as in <i>Cypris</i> . Quite simple. |
| CYTHERELLA, sub-gen. ? | Thick. | Ovate or oblong. | | | | |
| | | | | | No special hinge. | |

Sub-family—CYPRINÆ, Dana. (*Cyprididæ*, Baird.)

I have alluded to the difficulties in the way of the palæontologist when comparing the Tertiary *Cyprinæ* with their existing representatives; and in the following descriptions I shall not dwell on the probabilities of the agreement of any of our few fossil forms with the carapaces of *Cypria*, *Cyprois*, and *Notodromas*, but arrange them in two groups accordingly as the carapaces more or less resemble those of the known recent species of the genera CYPRIS and CANDONA.

At the same time it will be advisable to point out the anatomical characteristics of all the above-mentioned divisions, that the subject may be fairly presented in its zoological aspect.

Genus—CYPRIS, Müller. (*Monoculus*, Auct. prior.)

Animal swimming and creeping; inhabiting fresh water: eye single (coalesced): both pairs of antennæ plumed. Carapace more or less oblong, generally smooth and more or less setigerous; occasionally punctate; contact-margins thin and trenchant, furnished on the anterior, ventral, and posterior borders with an internal lamellar plate which projects freely and obliquely into the cavity of the valves, and is broadest at the anterior end of the valves; the edge of the right valve received within that of the left: dorsal edge simple; its central third (and sometimes more) slightly thickened, and more or less distinctly defined by an anterior and a posterior angle; these angles in general faintly project, the central portion of the margin between them being straight or slightly incurved: the ventral margin of each valve has its central portion somewhat incurved.

[*Sub-genus*—CYPRIA, Zenker.¹ 1854. (*Cypris*, Auct.)]

Animal like *Cypris*, but having a broader eye, more slender limbs with longer setæ (hence greater briskness of motion in swimming), a peculiar bag-like prolongation of the mucous gland in the male genital apparatus, longer and thinner spermatozoa, and a bending downwards of the ovary at first between the valves instead of upwards. Carapace like that of *Cypris*. (This includes, according to Zenker, *C. punctata*, Jurine, *C. Joanna*, Baird, *C. vidua*, Müller, *C. semilunaris* (?), S. Fischer, and *C. ovum*, Jurine.)

¹ Zenker has studied the anatomy of *Cypris* and *Cythere* with great care, and has published the result of his researches in considerable detail ('Archiv für Naturgeschichte,' 1854). Besides pointing out important distinctions in the limbs, shell-structure, chitine-skeleton, and eyes of these minute animals (and herein adding some valuable information to what has been before observed), he lays great stress on the structure of the alimentary and generative organs, and on the form of the spermatozoa, as characteristic of genera and species; and, although he has on these points accumulated a great mass of observations, both novel and important, yet he rightly intimates that the field is still open to investigators. His sub-genus *Cypria* and new genus *Cypriis*, mainly founded on peculiarities of internal structure, are introduced here to render the treatment of the subject more complete; although, for the purposes of the palæontologist, as I have already noticed, the distinction of these, and even of *Candona*, from *Cypris* is scarcely advantageous. Indeed, were it not that some of the fossil forms have been recognised in the recent state, and their generic characters in consequence definitely known, it would not be always practicable to decide to what divisions of the *Cyprinæ* the several carapaces really belong.

Genus—CYPROIS, Zenker. 1854. (*Cypris*, Auct. ? *Notodromas*, Liljeb. 1853.)

Animal like *Cypris*, excepting that the eye is almost completely divided, and the mucus-gland of the male genital apparatus is differently constructed. Carapace like that of *Cypris*. (To this genus Zenker refers *C. monacha*, Müller, and *C. dispar*, Fischer.)

Genus—NOTODROMAS, Liljeborg. 1853. (*Cypris*, Auct. ? *Cyprois*, Zenker. 1854.)

Animal like *Cypris*, excepting that the eye is double,—the second pair of maxillæ have no branchial appendage,—and the pencil of setæ on the lower pair of antennæ is very long. Carapace resembling that of *Cypris*. Liljeborg quotes *C. monacha*, Müller, only as belonging to this genus. Probably Zenker's genus *Cyprois* is the same as this; but some important points of comparison are still required to be worked out before, in this as in other instances, the researches of MM. Liljeborg and Zenker can be estimated at their full value.]

No. 1. CYPRIS SETIGERA, Jones. Plate I, fig. 6 *a*—6 *d*.

CYPRIS SETIGERA, Jones. Annals and Mag. Nat. Hist., 2d ser., vi, p. 25, t. 3, fig. 3 *a*—*c*.

INCH.

Length, $\frac{1}{2\frac{1}{3}}$

Recent?

Post-tertiary: Berkshire and Cambridgeshire.

Carapace ovate, somewhat pear-shaped: *valves* convex; obliquely curved on the dorsal, and nearly straight and somewhat incurved on the ventral border; narrower and tapering anteriorly; bordered by a narrow rounded marginal rim; covered with fine spines: *hinge-line* occupying rather more than the central third of the dorsal edge: *right valve* narrower, straighter on the dorsal, and more incurved on the ventral margin, than the left valve. *Lucid spots* six, arranged on two transverse parallel rows. (System B, see p. 5.)

Dorsal aspect acute-oval; *anterior*, oval.

Plentiful¹ in the Peat-deposits of the Kennet Valley² at Newbury, and in the Peat-marl of Cambridgeshire.³

¹ Probably this is also a *recent* species, although it has as yet apparently escaped notice. The somewhat similar carapaces figured and described by earlier authors are not sufficiently elucidated for exact and satisfactory comparison.

² For an account of these Peat-deposits, see the Appendix to my *Lecture on the Geology of Newbury &c.*, p. 40, 1854.

³ See 'Quart. Journal Geol. Soc.,' vi, p. 451.

In this species the dorsal edge is more angular, owing to the greater definition of the hinge-line, than in *Cypris aurantia*, Jurine, sp., to which *C. setigera* is nearly allied in general form.¹

Its ventral margin, also, is somewhat more inturned. The very spinous surface, so well preserved even in the fossil state, is markedly characteristic, in comparison with the partial distribution of setæ in *C. aurantia*. Its lucid spots are altogether differently arranged from those in the last-mentioned species, in which there are eight, forming a set of four, irregular, parallel, oblique lines (System A). And lastly the valves are smaller and somewhat less gibbose than those of *C. aurantia*.

No. 2. *CYPRIS BROWNIANA*, Jones. Plate I, fig. 1 *a*—1 *d*.

CYPRIS BROWNIANA, Jones. Annals and Mag. Nat. Hist., 2d ser., vi, p. 25, t. 3, fig. 1.

INCH.

Length, $\frac{1}{28}$

Pleistocene : Clacton, Essex.

Carapace short and broad, somewhat square: *valves* convex, depressed anteriorly, smooth, with a few scattered pedicles of setæ; edges of the valves rather thickened; inner marginal plate well developed: *hinge-line* occupying the central third of the dorsal border: *left valve* sub-quadrangular, obliquely rounded anteriorly, semicircular behind; ventral border and central third of dorsal border almost straight: *right valve* smaller than the left, sub-reniform. Lucid spots six, placed according to System B.

Dorsal aspect elongate and obtuse ovate; *anterior*, broad ovate.

Plentiful in the fresh-water deposit at Clacton, in Essex.

For these and other specimens of Entomostraca from Clacton I have to thank John Brown, Esq., F.G.S., of Stanway, near Colchester, who has assiduously worked out the fossil fauna of the Clacton, Copford, and other Pleistocene and Post-tertiary deposits, and after whom the species under notice has been named.

Var. *TUMIDA*, Jones. Plate I, fig. 2 *a*, 2 *b*.

CYPRIS TUMIDA, Jones. Annals and Mag. Nat. Hist., 2d ser., vi, p. 26, t. 3, fig. 2.

INCH.

Length, $\frac{1}{35}$

Pleistocene : Grays, Essex.

¹ *Cypris pubescens*, Koch, 'Deutsch. Crust.,' 1837, Heft xi, t. 6; *C. ovato-conchacea*, De Geer, sp., 'Hist. Insect.,' vii, t. 29, figs. 5—7; *C. conchacea*, Jurine, sp., 'Hist. Monocl.,' t. 17, fig. 7; and *C. conchacea*, Koch, 'Deutsch. Crust.,' 1838, Heft xxi, t. 12—14, also more or less resemble the species under notice.

Carapace tumid, rounded: *valves* strongly convex, especially on the posterior third; rounded obliquely and subacute anteriorly, semicircular posteriorly; arched on the dorsal, nearly straight on the ventral border: *surface* finely punctate with pedicles of setæ. *Lucid spots* in System B.

Dorsal aspect sub-oblong; *anterior*, broadly ovate.

This variety differs from *C. Browniana*, from Clacton, in its smaller size, greater rotundity, more acute anterior extremity, and more frequent setation. It is of rare occurrence, and found as yet only in the fresh-water clayey sand of Grays in Essex.¹

For these and other specimens from Grays and Copford I am indebted to John Pickering, Esq.

No. 3. CYPRIS OVUM, *Jurine*, sp. Plate I, fig. 4 *a*, 4 *b*.

MONOCULUS OVUM, *Jurine*. 1820. Hist. des Monocles, &c., p. 179, t. 19, figs. 18, 19.

CYPRIS VULGARIS, *Zadduch*. 1844. Synop. Crust. Pruss. Prodomus, p. 35.

— MINUTA, *Baird*. 1850. Nat. Hist. Brit. Entom., p. 155, t. 18, figs. 7, 8.

— — *Jones*. 1850. Ann. and Mag. Nat. Hist., 2d ser., vi, p. 28.

— PANTHERINA, *S. Fischer*. 1851. Ueber das Genus Cypris, &c., p. 163, t. 11, figs. 6—8.

— OVUM, *Liljeborg*. 1853. De Crustaceis, &c., p. 113, t. 10, figs. 13—15.

— (CYPRIA) OVUM, *Zenker*. 1854. Monographie der Ostracoden, &c., p. 79, t. 3, B.

INCH.

Length, $\frac{1}{40}$

Recent: England; Europe.

Post-tertiary: Cambridgeshire.

Carapace small, tumid, egg-shaped: *valves* highly convex, triangularly oval; dorsal margin arched and almost angular, ventral straight; ends rounded, posterior extremity broadest: *surface* finely punctate. In the recent state the valves are beset all round towards the margins with short hairs; and they are of a light-brown colour, with a tinge of green (*Baird*).

Dorsal aspect broadly ovate; *anterior*, nearly round.

Common in ponds and stream. Abundant in the marl of the Peat-deposits of Cambridgeshire described by Mr. Hamilton in the 'Quart. Journ. Geol. Soc.,' vi, p. 451.

¹ For the geological conditions of the Pleistocene and Post-tertiary deposits in Essex, see (*Grays*) Loudon's 'Mag. Nat. Hist.,' 1836, ix, p. 261; 'Mag. Nat. Hist.,' n. s., 1838, ii, p. 546; (*Clacton*) 'Mag. Nat. Hist.,' n. s., 1838, ii, p. 163, and 1840, iv, p. 197; 'Proc. Geol. Soc.,' 1845, iv, p. 523, and 'Quart. Journ. Geol. Soc.,' i, p. 341; (*Copford*) Loudon's 'Mag. Nat. Hist.,' 1834, vii, p. 436, and 1836, ix, p. 429; 'Proc. Geol. Soc.,' 1843, iv, p. 164; 'Quart. Journ. Geol. Soc.,' 1852, viii, p. 184.

No. 4. CYPRIIS GIBBA, *Ramdohr*. Plate I, fig. 3 *a—f*; and Woodcut, fig. 1, p. 16.

CYPRIIS GIBBA, *Ramdohr*. Magaz. d. Gesellsch. Naturforsch. Freunde zu Berlin, 1808, ii, p. 91, t. 3, figs. 13—17.

MONOCULUS BISTRIGATUS, *Jurine*. Hist. des Monocles, p. 177, t. 19, figs. 12, 13.

CYPRIIS BIPPLICATA, *Koch*. Deutschlands Crustac., &c., Heft 21, t. 16.

— — *S. Fischer*. Mém. Sav. Etrang. Petersburg, vii, p. 150, t. 5, figs. 5—8.

— SINUATA, *Ib.* Mém. Sav. Etrang. Petersburg, vi, p. 193, t. 10, fig. 4.

— BISTRIGATA, *Liljeborg*. De Crustaceis, &c., p. 121, t. 11, figs. 17, 18.

— GIBBA, *Jones*. Ann. and Mag. Nat. Hist., 2d ser., vi, p. 26, t. 3, fig. 4.

INCH.

Length, $\frac{1}{25}$

Recent: England; Europe.

Post-tertiary: Cambridgeshire.

Pleistocene: Kent; Essex.

Carapace oblong, compressed: *valves* larger anteriorly than posteriorly; rounded obliquely in front; rounded behind; straight on the dorsal, incurved at the middle of the ventral border; marked across the middle by two unequal parallel furrows, situated side by side, and strongest towards the dorsal border; these two sulci (the foremost of which often becomes obsolete) form an irregular impression which divides the surface into two nearly equal, slightly gibbose portions, each of which in old specimens is sometimes surmounted with a tubercle (Plate I, fig. 3 *a*). In young individuals the impression is scarcely perceptible (fig. 3 *e*). *Surface* of the valves impressed with closely set circular punctations (fig. 3 *f*), which are either irregular in their disposition, or follow wavy lines, rather concentric as to the two halves (anterior and posterior) of the valves. Irregular pits and knobs are frequent near the middle of the adult valve.

The *hinge* is well seen on the smaller (right) valve, and consists of a straight, simple, smooth ridge, extending nearly the whole length of the dorsal border, and slightly modified at its posterior portion, where it becomes somewhat broader and sulcated. The *inner marginal plates* of the valves are rather feebly developed.

The recent individuals have usually a dull yellowish colour, and, like the fossil forms, vary considerably both as to the extent to which the ventral border is incurved, and as to the development of the vertical median sulci and their attendant pits and varices, and other irregularities of the surface.

Dorsal aspect elongate-oval or lanceolate; *anterior*, ovate.

This is a very common species in our fresh-water ponds and rivers; but, as *Ramdohr* has remarked (*loc. cit.*), it has the habit of remaining on or in the mud rather

than swimming in the water and crawling on the weeds. Hence it has escaped observation to some extent, and is not noticed in Dr. Baird's 'History of the British Entomostraca.' In its love of the mud and habit of crawling, it so much resembles the *Candonæ* that I have been anxious to verify Dr. Ramdohr's description of the species; and I find that it truly possesses the pencilled tufts characteristic of the genus *Cypris*. See Woodcut, fig. 1. (See also the figures by Fischer, Koch, &c.)



1. *Cypris gibba*.
2. *Cyprideis torosa*
- aa. Upper pair of antennæ.
- bb. Lower or pediform antennæ.
- c. First pair of feet.

Cypris gibba occurs fossil in the Peat-marl of Cambridgeshire before referred to (where, however, only young specimens were met with); in a Pleistocene deposit at Wear Farm, near the Reculvers, described by Mr. Prestwich in the 'Quart. Journ. Geol. Soc.,' xi, p. 112; and plentifully in the fluviatile deposits of Grays and Clacton, in Essex.

From the association of a few marine or estuarine fossils (*Balanus* and *Globulina*) with *C. gibba* in the Pleistocene sands near the Reculvers, it appears that this species can inhabit brackish water.

Genus—*CANDONA*, Baird. (*Cypris*, Auctorum.)

Animal creeping; (inhabiting fresh water and found on or in the mud; generally larger than *Cypris*;) eye single (coalesced); the upper pair of antennæ plumed; the lower pair plumeless, merely setiferous and hooked.¹ *Carapace* like that of *Cypris*.

No. 1. *CANDONA REPTANS*, Baird. Plate I, figs. 7 a—7 e.

CANDONA REPTANS,² Baird. Hist. Brit. Entom., p. 160, t. 19, fig. 3.

— — Jones. Annals and Mag. Nat. Hist., 2d ser., vi, p. 27, t. 3, fig. 7.

CYPRIS REPTANS, Liljeborg. De Crustaceis, &c., p. 123, t. xi, figs. 21—23; t. xii, figs. 7—9.

INCH.

Length, $\frac{1}{5}$

Recent: Britain; Europe.

Post-tertiary: Berkshire; Cambridgeshire; Lincolnshire; Essex.

Pleistocene: Essex.

¹ According to Liljeborg, in the species which he refers to *Candonæ* the second pair of maxillæ are without branchial appendages.

² Leach's *Cypris viridis* ('Edinb. Encycl.,' t. 221, fig. 2), and *C. nephroides* ('Encycl. Brit. Suppl.,' 20, figs. 1, 2), somewhat resemble *Candonæ reptans* (as pointed out to me by Dr. Baird); but it is impossible to come to a satisfactory determination from Leach's figures and notes.

Carapace large, oblong, almost cylindrical, smooth, shining, beset with scattered setæ (of a greenish colour, with variations of tint in patches, and hairy at the margins, in the recent state); anterior portion compressed, obliquely rounded, and tapering forwards and downwards; posterior rather less compressed than the anterior extremity, almost squared, but with the angles well rounded; dorsal margin straight along the middle, suddenly rounded posteriorly, and gently curving anteriorly towards the antero-ventral margin; ventral margin slightly incurved.

Hingement simple. *Lucid spots* large, elongate, 6—8, arranged in four irregular, parallel, oblique rows (System A); in the outside pairs the spots coalescing one with another.

Dorsal profile lanceolate; *end view* broadly and acutely ovate.

Fig. 7 *a* represents a variety, from Clacton, which was much more setiferous (as evidenced by the remaining pedicles of setæ), and usually of smaller size, and marked with proportionally larger lucid spots. I have met with this variety in a recent state in beach-sand from Pegwell Bay, with which my friend Mr. Pickering has favoured me, where it was associated with *Candona lucens* and *Cytherideis trigonalis*; but of the exact habitat of these specimens I have no precise information.¹

Candona reptans is referred by Liljeborg to his section of *Cyprides* with very short setæ on the pediform antennæ. I cannot find on our specimens even the six setæ mentioned by this author. The one large and three small setæ at the third joint of the second pair of antennæ poorly represent the filamentous brush of the *Cypris*. The character of the second pair of maxillæ, referred to by Liljeborg, is an important peculiarity; possibly the two animals are distinct. I prefer following Baird in the allocation of the species under notice, which is characteristically a *Candona* in its make and habits.

Candona reptans is one of the largest of the bivalve Entomostracans met with in our fresh waters, and is of frequent occurrence. It is plentiful in a fossil state in the peat-deposits of Berkshire, at Newbury, and in the fresh-water marl in the fens of Cambridgeshire, described by Mr. Hamilton;² it occurred also in the fresh-water deposit met with in the Casewick railway-cutting, in Lincolnshire, and described by Mr. Morris, 'Quart. Journ. Geol. Soc.,' ix, p. 321, and at Edwardstone;³ and it is not rare in the pleistocene sands and clays of Clacton and Grays, in Essex. The specimens from Clacton, as already mentioned, are comparatively small: those from Grays are often very large.

¹ They were probably brought down by the river Stour.

² *Loc. cit.*

³ About thirteen miles from Stanway, Essex. Mr. J. Brown kindly communicated some fine specimens obtained from the post-tertiary deposits at this place.

No. 2. CANDONA FORBESII, Jones. Plate IV, figs. 8, 9, 11 a, 11 b.

CANDONA FORBESII, Jones. Memoirs Geol. Survey, p. 157, t. 7, fig. 22.

INCH.

Length, $\frac{1}{14}$

Upper Eocene: Isle of Wight and Hampshire.

Valves oblong, rounded at the extremities, narrowest and most depressed anteriorly, most convex at the posterior third; hinder border margined with a slightly raised rim; dorsal border arched, ventral slightly incurved; surface smooth; fine punctations are visible in transparent specimens under the microscope with transmitted light. *Lucid spots* according to System A.

This species much resembles the recent *Candona reptans* and *C. Richardsoni* (Jones) of the Woolwich Beds; but certain modifications of shape and proportional size separate all these forms.

Candona Forbesii occurs in great numbers, and in different stages of growth, chiefly as single valves, compressed between the laminæ of the shales of the Upper, Middle, and Lower Hempstead Series at Hempstead Cliff, Isle of Wight; and in a better state of preservation in the pyritous bands occurring in that series. It is met with also compressed in the Shales of the Osborne Series at Cliff End, Colwell Bay; and is found also at Hordwell (Mr. F. Edwards's collection).

I have dedicated this abundant and characteristic species to Edward Forbes, whose name is so intimately associated with the Hempstead deposits and their fossils.

No. 3. CANDONA RICHARDSONI, Jones. Plate IV, figs. 12 a, 12 b.

CANDONA RICHARDSONI, Jones. Quart. Journal Geol. Soc., x, p. 162, t. 3, fig. 13.

INCH.

Length, $\frac{1}{20}$

Lower Eocene: Woolwich.

Valves oblong, smooth, rounded at the extremities, depressed anteriorly, most convex just posterior to the centre; ventral border straight, dorsal border very slightly curved.

This species approaches in shape to the recent *Candona reptans*; but it is more oblong, and in size it is much inferior. It also resembles *C. Forbesii* of the Isle of Wight.

Candona Richardsoni was found by Mr. W. H. Baily, in the thin band with *Hydrobia*, *Planorbis*, and *Cyrena*, in the Woolwich sand-pit. The individuals are

numerous, compressed between the laminæ of the clay. Casts of valves possibly referable to the same species were collected by the late Rev. H. M. de la Condamine, F.G.S., of Blackheath, in the Planorbis-bed at Counter Hill, near Lewisham.

No. 4. *CANDONA CANDIDA*,¹ *Müller*. Plate I, figs. 8 *a*—8 *f*, 5 *a*, 5 *b*.

CYPRIS CANDIDA, *Müller*. Entom., p. 62, t. 6, figs. 7—9.

MONOCULUS CANDIDUS, *Jurine*. Hist. des Monocles, p. 176, t. 19, figs. 7, 8.

CYPRIS LUCENS, *Baird*. Trans. Berwick Nat. Club, i, p. 100, t. 3, fig. 15.

— *CANDIDA*, *Ib.* Mag. Zool. Bot., ii, p. 134, t. 5, fig. 3.

— — *Zaddach*. Synops. Crust. Pruss. Prodomus, p. 38.

CANDONA CANDIDA, *Baird*. Trans. Berwick Nat. Club, ii, p. 153.

CYPRIS PELLUCIDA, *Koch*. Deutschland's Crust., &c., xi Heft, t. 5.

— *LUCIDA* (?), *Ib.* Deutschland's Crust., &c., xxi Heft, t. 18.

CANDONA LUCENS, *Baird*. Hist. Brit. Entom., p. 160, t. 19, fig. 1. [Adult female.]

— — *Jones*. Annals and Mag. Nat. Hist., vi, p. 26, t. 3, fig. 8.

CYPRIS PELLUCIDA, *S. Fischer*. Ueber das Gen. Cypris, &c., p. 148, t. 5, figs. 1—4.
[Female.]

CANDONA CANDIDA, *Liljeborg*. De Crustaceis, &c., p. 127, t. 11, figs. 19, 20; t. 25, figs. 13—15.

INCH.

Length, $\frac{1}{35}$

Recent: England; Europe.

Post-tertiary: Forfarshire; Berkshire; Cambridgeshire; and Essex.

Pleistocene: Essex.

Carapace rather large, long kidney-shaped, somewhat cylindrical, smooth, shining (pearly white in the recent state; often milky white when fossil); beset with scattered pedicles of setæ (and fringed with hairs, when recent); posterior portion larger than the anterior, in the adult female curving boldly backwards and downwards, and terminating in a blunt point (injured in the lithograph, fig. 8 *a*); dorsal margin arched, especially behind; ventral margin more or less incurved. *Lucid spots* six in a group, forming a transverse, curved, front row of four, with two other spots behind the lowest two of the front row (System B), figs. 8 *e*, 8 *f*; this arrangement is subject to a variation, by which the lower five spots in the two rows lose their linear regularity (fig. 5 *b*), and sometimes become so obliquely arranged as to converge into a radiate figure, forming a star or rosette, accompanied by the upper isolated sixth spot, as seen in the fragment of a valve, fig. 5 *a*.

¹ Zenker (1854), *op. cit.* p. 76, refers to this species as a *Cypris*, with the following synonyms:

CYPRIS CANDIDA, *Müller*; *C. COMPRESSA*, *Koch*; *C. PELLUCIDA*, *Ib.*; *C. PUBESCENS*, *Ib.*;
C. PELLUCIDA, *S. Fischer*; *C. PIGRA*, *Ib.*; *C. COMPRESSA*, *Ib.*

Dorsal profile lanceolate, or elongate-oval, with the ends acute and nearly equal; *anterior*, broadly ovate.

Candona candida is very common in the mud of ponds and rivers; and occurs equally abundantly in the peat-deposits of Berkshire (at Newbury), and Cambridgeshire; in the shell-marl of the Forfarshire lakes, described by Sir C. Lyell, 'Geol. Trans.,' 2d ser., vol. ii, p. 73; in the fresh-water beds at Copford; and in the pleistocene beds of Clacton and Grays, in Essex.

No. 5. CANDONA (?) SUBÆQUALIS, *spec. nov.* Plate I, fig. 9 a—9 c.

INCH.

Length, $\frac{1}{15}$

Recent?

Post-tertiary: Essex.

Carapace rather large, very convex, reniform; anterior and posterior extremities nearly equal; dorsal margin arched, the curve being nearly uniform throughout its length; ventral margin incurved. *Surface* thickly studded with fine pimples, or pedicles of setæ. *Lucid spots* 7—8, forming four irregular oblique rows (System A).

This species differs from *C. candida* in its shape, setation, and lucid spots; but resembles it in general character. It much resembles in outline *Cypris lutraria*, Koch ('Deutsch. Crust.,' xxi Heft, t. 15), and *C. elliptica*, Baird ('Hist. Brit. Entom.,' p. 158, t. 19, fig. 12); but the means of comparison at command are unsatisfactory.

Candona (?) *subæqualis* occurs not uncommonly in the post-tertiary fresh-water deposit at Copford, near Colchester.

Sub-genus (?)—CYPRIDEIS, *nov.*

[At page 9 (in a note added while these sheets were in the press,) I have mentioned my reasons for expecting that, on further examination, this form will prove to be a *Cythere*. As I have not had any opportunity of getting living specimens, I leave the description of this interesting and peculiar form in the place it occupied in my MS., and under the same provisional subgeneric heading. (November, 1856.)]

*Animal*¹ having the pediform antennæ hooked, not plumous, and the superior antennæ apparently simply setiferous. *Carapace* oblong; marginal edges thickened,

¹ Not yet examined in a fresh state.

inner plates obsolete; contact-margin of the left valve grooved or rabbeted for the reception of the slightly flanged edge of the opposite valve, and the dorsal edge provided with hinge-teeth, consisting of a longitudinal series of numerous minute tubercles, with corresponding pits; on the right valve the dorsal edge is tubercled or toothed along its anterior and posterior thirds, and pitted in the central portion; whilst the left valve has fine teeth on the middle part, and pits on the rest of its dorsal edge: *surface* of the valves punctated. In its hingement, *Cyprideis* closely resembles the marine form *Cytheridea*.

NO. 1. CYPRIDEIS TOROSA, Jones. Plate II, figs. 1 *a*—1 *i*; and WOODCUT, fig. 2 p. 16.

CANDONA TOROSA, Jones. Annals and Mag. Nat. Hist., 2d ser., vi, p. 27, t. 3, fig. 6.

INCH.

Length, $\frac{1}{20}$

Recent: Gravesend.

Pleistocene: Essex and Kent.

Carapace oblong, varying in its proportions according to age. *Valves* convex; bearing for the most part a slightly raised marginal rim on all edges except the dorsal; rounded before and behind; straight on the ventral, and more or less arched on the dorsal border; right valve less oblong, smaller, and narrower posteriorly than the left valve. The *surface* of the valves is marked with closely set angular pittings (fig. 1 *i*), coarse in the older specimens, and is raised in adult specimens into 5—7 tubercles. Young individuals in general have the surface almost even, or marked by a slight transverse sulcus near the centre and just posterior to the lucid spots, which indicate the position of the first-developed tubercle; 3—4 tubercles on the posterior moiety of the valve, and 1—3 smaller tubercles anteriorly, become apparent afterwards. Occasionally well-developed tubercles are present in small, and even in young specimens; and, on the other hand, individuals reach a large size without being marked with more than one (anterior) tubercle.

The *hinge* is considerably developed (figs. 1 *g*, 1 *h*); the hinge-margin of the right valve bearing anterior and posterior sets of “knurlings,” which are received into corresponding pittings on the hinge-margin of the opposite valve; whilst the central portion of the hinge has a smaller set of similar pits and teeth, but inversely arranged.

Lucid spots small, four, arranged in a single transverse, or vertical, row immediately behind the chief, or anterior, tubercle (System c).

Dorsal aspect irregular-acute-oval; *anterior*, somewhat hexagonal.

This well-marked species occurs abundantly in the pleistocene sands of Grays, Essex, and was found in equal profusion in deposits of similar age at Wear Farm.

near the Reculvers,¹ Kent, by Mr. Prestwich, and at Chislet, between Wear Farm and the Grove Ferry Station, by Mr. J. Brown, of Stanway; to both of whom I am indebted for a liberal supply of specimens. At the two last-mentioned localities the carapaces are not so strongly tubercled as they are at Grays.

Cyprideis torosa is also a recent species, living in the Gravesend ditches, where Mr. Pickering (who kindly favoured me with my recent specimens of this species) found it in great numbers, attached to the cases of Caddis-worms, "in a ditch which runs on the land-side of the Thames Bank, between Gravesend Town and Coal House Point, near an old mill: the water flowing into and not from the Thames, except at high tides."

Sub-family—CYTHERINÆ, Dana. (*Cytheridæ*, Baird.)

In this second sub-family of the *Cypridæ* (Dana) we meet with similar difficulties in the allocation of the fossil carapaces to generic forms as among the *Cyprinæ*; for, although the carapaces are readily arranged into natural groups according to their peculiarities of structure, yet these peculiarities do not necessarily indicate generic differences among the animals to which they belonged; and, in fact, in this branch of palæontology, as in others, we have still to wait for an intimate knowledge of living animals before we can confidently speak of the exact relations of the fossil remains of earlier creatures, which they more or less closely represent. *Cytherella*, *Bairdia*, *Cytherideis*, *Cytheridea*, and *Cythereis* exist in the present seas, as well as *Cythere* proper; and favorable opportunities will, it is hoped, occur for their minute examination in a fresh state.

The *Cytheres* of the Baltic have been carefully examined by Liljeborg and Zenker, but the result of their examinations does not much assist the palæontologist in the comparison of the recent and fossil forms. The views of these two authors on the synonymy of some of the best known of the recent species are at variance;² nor do

¹ Where it seems to have inhabited brackish water; 'Quart. Journ. Geol. Soc.' xi, p. 112.

² According to Liljeborg, the Swedish species which he examined are three, viz.:

CYTHERE GIBBERA, Müller.

— VIRIDIS, *Ib.* Syn. *C. lutea*, Müller; *C. albomaculata*, Baird; and
C. alba, Baird (young).

— NITIDA, Liljeborg.

Zenker arranges his species from the Cattegat and the Baltic thus—

CYTHERE LUTEA, Müller. Syn. *C. reniformis*, Baird.

— GIBBA, *Ib.* Syn. *C. gibbera*, Müller. (Male and Female.)

FLAVIDA, *Ib.*

— VIRIDIS, *Ib.* Syn. *C. variabilis*, Baird.

they even recognise the same forms for Müller's species, except in the case of *C. gibba* and *C. gibbera*. Liljeborg figures as *C. viridis* of Müller what Zenker figures as Müller's *C. flavida*; and Zenker figures as *C. viridis* a form that approximates to Liljeborg's *C. nitida*. Liljeborg's view of *C. viridis* appears to me to be correct: Zenker's *C. flavida* should be referred to the same species; Müller's *C. flavida* being a different form.

S. Fischer has lately ('Munich Transactions,' 1855) further illustrated one of Müller's species, and two new forms.

Genus—CYTHERE,¹ Muller.

Animal creeping; chiefly marine.² Eye single, the coalescence of which is more or less imperfect: upper antennæ setiferous, but not presenting a filamentous plume; lower antennæ hooked and furnished with a single, long, jointed filament; feet three pairs. The *carapace-valves* are usually ornamented on their anterior and posterior borders with a marginal series of fine spines or denticulations, which are coarsest in the sub-genus *Cythereis* and finest in *Bairdia*.

CYTHERE proper.

Carapace often very convex, especially on the ventral portion; sometimes smooth and setigerous, generally pitted, and occasionally reticulated; varying in outline from an acute-oval to an irregular oblong; in the first case it often resembles a peach-stone in miniature; in the latter case a central and two posterior tubercles sometimes give a character to the valves;³ and in each case the anterior, and sometimes the posterior, hinge forms an indistinct angle on the dorsal edge; the hinge-line of each valve occupies about the middle third of the dorsal margin, and presents a ridge or bar and a furrow, the bar on one valve corresponding to the furrow on the other; the bar is sometimes blended with the edge of the valve, and is occasionally finely crenulated;

¹ For synonyms, see 'Monog. Entom. Cret., 1849, p. 8.

² *Cythere inopinata*, Baird, and another species referred to by Say, are the exceptional species in this respect. According to Zenker, one species, at least, of marine *Cytheres* can live for several days in fresh water; and, on the other hand, S. Fischer describes a *Cypris* from saltish water at the mouth of the Neva, and another from the sea-water of the harbour at Alexandria.

³ The central tubercle is internally a shallow pit, associated with lucid spots and marking the place of muscular attachment.

it is more or less developed at its extremities into cardinal processes or teeth, which, with still stronger, but isolated, teeth at the ends of the furrow on the opposite valve form the anterior and posterior hinges of the carapace: the ventral margin of each valve is more or less incurved near the middle, where its edge is frequently produced (as also occasionally in *Cypris*) into a thin projecting laminar curvilinear plate. The posterior border being always depressed and contracted, and frequently notched at its dorsal angle, forms a low subacute marginal rim or "posterior lobe," of varying breadth.

[*Oval forms of CYTHERE proper.*]

No. 1. *CYTHERE PUNCTATA*, Münster. Plate II, figs. 5 *a*—5 *h*.

CYTHERE PUNCTATA, Münster. Jahrb. f. Min., &c., 1830, p. 62.

CYTHERINA PUNCTATA, Roemer. Neues Jahrb. f. Min., &c., 1838, p. 515, t. 6, fig. 2.

CYPRIDINA PUNCTATA, Reuss. Haidinger's Abhandl., iii, p. 68, t. 9, fig. 24.

— *PUNCTATELLA*, *Ib.* Haidinger's Abhandl., iii, p. 65, t. 9, fig. 15. (Young of *C. punctata*?)

CYTHERE PUNCTATELLA, Bosquet. Mém. Couron. Acad. Belg., xxiv, p. 75, t. 3, fig. 12. (Young of *C. punctata*?)

INCH.

Length, $\frac{1}{30}$

Recent: Britain; Europe.

Pliocene: Suffolk.

Upper and Middle Tertiary: Europe.

Middle Tertiary: Maryland?

Carapace broadly sub-ovate, resembling a peach-stone in miniature, most convex towards the middle of the ventral portion; right valve (fig. 5 *b*) narrower than the left, and its hinge-line more oblique: *surface* of the valves coarsely pitted with sub-hexagonal serial punctations (fig. 5 *h*), and in the old specimen¹ (fig. 5 *a*), marked on the anterior portion with concentric raised lines, or faint ridges, near the margin; the pittings and the marginal concentric lines (which latter rarely occur) are both subject to variation in their relative size and distinctness, according to the age of the individuals. In young specimens (fig. 5 *e*), both the shape and the punctation resemble that of *C. punctatella*, Reuss.

This species occurs plentifully in the Crag of Suffolk, together with *C. Woodiana*, &c. It has been found also in the Austro-Hungarian Tertiaries by Reuss; and at Palermo and Castell' Arquato by Münster. I have it from the Bordeaux sand, and a scarcely distinguishable variety from Maryland, United States. *C. punctatella* occurs also in the Austro-Hungarian Tertiaries, and at Castell' Arquato, Bordeaux, and Perpignan.

¹ This specimen is not quite perfect, the posterior lobe having been broken away.

The following localities yield varieties apparently indistinguishable from *C. punctata*,—Southend (near the mouth of the Thames), Poole Bay (Dorset), Devonshire Coast, Tenby, and Arran; also Australia.

Numerous allied forms of this punctated peach-stone-like group of *Cytheres*, generally of small size, are common in the Oolitic, Cretaceous, and Tertiary deposits, and in the present seas.

No. 2. *CYTHERE TRIGONULA*, *spec. nov.* PLATE III, figs. 1, *a*—1, *h*.

INCH.

Length, $\frac{1}{20}$

Pliocene: Suffolk.

Carapace ovately subtriangular, depressed on the anterior, dorsal, and posterior borders, and strongly convex ventrally, where the valves are, as it were, pinched up into an obtuse ventral ridge, surmounted by a slight longitudinal fold; the surface of each valve gradually rises outwards from the dorsal edge to the ventral border, and is then suddenly bent inwards, so that the ventral surface of the closed carapace is flat, and that of the dorsal culminate; the transverse section of the carapace being triangular: *surface* finely punctate, with small round pits (fig. 1 *h*): *hinges* strongly developed.

Dorsal aspect lanceolate; *end view* triangular.

Cythere trigonula is plentiful, and accompanies *C. punctata*, in the Crag of Suffolk. Its triangular shape and larger size well distinguish it from its companion; and the pits of its punctation are relatively smaller.

No. 3. *CYTHERE TRIANGULARIS*, *Reuss.* PLATE VII, figs. 5 *a*—5 *g*.

CYTHERE TRIANGULARIS, *Reuss.* Zeitsch. Deutsch. Geol. Gesell., vii, p. 279, t. 10, fig. 3.

INCH.

Length, $\frac{1}{20}$

Lower Eocene: London.

Cretaceous: Basdorf, Mecklenburg.

Carapace gibbose, ovato-triangular; dorsal margin straight; extremities obliquely rounded and toothed; hinder end narrowest; ventral portion of each valve strongly convex, surmounted by a narrow, well-defined, spinous, longitudinal, slightly curved ridge or fold, and turned suddenly inwards, so as to form a flat ventral face to the closed carapace: *valves* thin, smooth, shining, and beset with scattered setæ: *hinge*

long, delicate, and well-defined, the median bar and furrow elongate and simple, but the anterior and posterior isolated teeth on the right valve are knurled or crenulated, their surfaces presenting 4—5 minute rounded knobs or denticles, which fit crenulate furrows on the other valve.

Dorsal aspect irregularly ovate, with the ends produced; *end-view* triangular, with the lateral lines slightly curved.

The specimens which I here refer to *C. triangularis*, Reuss,—agreeing with that species in all essential particulars,—occurred not unfrequently in the London Clay, from the excavations made for the Great Northern Railway in the Copenhagen Fields, north of London, and were obtained by Mr. J. Purdue, to whom I am indebted for the majority of my specimens from the London Clay. Reuss describes his specimens as occurring in the Cretaceous deposits at Basdorf, near Kröpelin, in Mecklenburg; several of the microzoa of these beds, as Reuss well remarks, have a tertiary aspect.

No. 4. CYTHERE WETHERELLII, Jones. PLATE IV, fig. 15; Pl. VI, figs. 16 *a*—16 *d*.

CYTHERE WETHERELLI, Jones. Quart. Journ. Geol. Soc., x, p. 161, t. 3, fig. 9.

INCH.

Length, $\frac{1}{3}\frac{1}{8}$

Middle Eocene: Isle of Wight.

Carapace irregularly ovate; contracted posteriorly; convex and somewhat flattened towards the ventral portion; suddenly inturned and flattened along the ventral border; bearing a subtriangular impression at about the middle of the dorsal portion of each valve; *surface* of the valves ornamented by a delicate reticulation, the meshes of which are formed by slightly raised anastomosing borders; reticulation fading away towards the dorsal margin: *hinge* delicate, presenting a modification of the hind and front teeth of the right valve, which are finely knurled, and connected by a continued fine knurling of the edge of the valve, whilst the median bar and furrow are obsolete.

Dorsal aspect narrow-oblong, with the ends angular and produced; *end-view* almost quadrangular, somewhat pentagonal.

Cythere Wetherellii is not uncommon in the Middle Eocene Sands of Colwell Bay, Isle of Wight, and also in an Oyster-band¹ of this series at the same locality. One

¹ Some years since a handful of this clay with remains of oysters was given to me as having been brought from Woolwich; and the species of *Entomostraca* which I had obtained from it (viz., *C. Wetherellii*, *C. plicata*, and *C. angulatopora*) were in consequence enumerated in the 'Quart. Journ. Geol. Soc.,' vol. x. p. 160, as belonging to the Woolwich series. Since then I have satisfied myself of the incorrectness of the stated locality of this clay. The above-mentioned species must therefore be regarded as belonging to the Middle, and not the Lower, Eocene.

specimen was also received from Mr. F. Edwards among his specimens of Entomostraca from Barton.

No. 5. CYTHERE STRIATOPUNCTATA, *Roemer, sp.* PLATE V, figs. 6, 7 *a*—7 *c*, 10.

CYTHERINA STRIATOPUNCTATA, *Roemer*. Neues Jahrb. f. Min., &c., 1838, p. 515, t. 6, fig. 2.

CYTHERE STRIATOPUNCTATA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 62, t. 3, fig. 1.

INCH.

Length, $\frac{1}{20}$

Middle Eocene: England and Europe.

Carapace ovate, very convex, subcylindrical, somewhat resembling a walnut in miniature; right valve (pl. 5, figs. 6, 10) less uniformly ovate than the left valve (pl. 5, figs. 7 *a*), narrower, and more angular on the dorsal border; anterior and posterior margins of the valves usually denticulate: *surface* ornamented with deep concentric furrows, curving round the anterior part of the valve, converging posteriorly, and becoming more or less straight and parallel at the centre; the furrows are crossed at short intervals by slight ridges, connecting the stronger concentric ridges which define the furrows, and forming unequal reticulation, each mesh of which is, for the most part, pierced at its centre by a well-marked pit.

M. Bosquet has examined the specimen on which *C. pertusa*, *Roemer, loc. cit.* t. 6, f. 2, was founded as a species, and he regards it as the young of *C. striatopunctata*.

Cythere striatopunctata is very abundant in the Barton Clay of the Hampshire Coast (Middle Eocene), and is plentiful in equivalent deposits at High Cliff, on the same coast. It occurs also at Bracklesham, and in a bed of sandy clay with green grains (silicate of iron) at Alum Bay, Isle of Wight (numbered 29 in Mr. Prestwich's section, 'Quart. Journ. Geol. Soc.,' ii. p. 257, t. 9), containing a small, depressed, undescribed Nummulite,¹ and belonging to the Barton series (Middle Eocene).

M. Bosquet has found it in the "Sables moyens," the "Calcaire grossier," and the "Sables inférieurs" of France, and in the "Sable à grès calcifère" and the Lower Tongrian beds of Belgium. Roemer described it from the Paris Tertiaries.

No. 6. CYTHERE CONSOBRINA, *spec. nov.*

INCH.

Length, $\frac{1}{20}$

Middle Eocene: Barton, Hants.

Carapace elongate-oval, subcylindrical; obliquely rounded in front; contracted

¹ See also 'Quart. Journ. Geol. Soc.,' viii, p. 334, *note*.

behind; posterior lobe narrow, depressed, and rounded; dorsal border slightly arched; ventral border nearly straight: *valves* gibbous, smooth, faintly punctate, most convex posteriorly and ventrally.

Dorsal aspect elongate-ovate; *end-view* orbicular.

The species here described [which was found after the plates were finished] is very near to *Cythere Favrodiana*, Bosquet ('Mém. Commiss. Carte géol. Neerl.,' p. 80, t. 8, f. 7; and 'Mém. Soc. Roy. Liège,' iv., p. 361, t. 1, f. 5); its outline, however, is more oval; its posterior lobe is not so acute; and its surface is more uniformly convex, and is punctate. It has other allies in *C. fusiformis*, Bosquet, and *C. attenuata*, presently to be described.

Cythere consobrina occurs rarely in the Barton Clay, Hampshire. [Mr. F. Edward's Collection.]

No. 7. CYTHERE ATTENUATA, *spec. nov.* PLATE V, fig. 11.

INCH.

Length, $\frac{1}{30}$

Middle Eocene: Isle of Wight.

Carapace elongate-ovate, subcylindrical, rounded and slightly tapering anteriorly; obliquely acuminate posteriorly; dorsal border slightly oblique, and forming an angle with the posterior border; ventral border curved; valves somewhat depressed in front, and produced behind into an angular, suddenly flattened posterior lobe: *surface* smooth, convex, and marked on the middle of the ventral portion with a slight triangular impression [not well shown in the figure].

Cythere attenuata approaches *C. inornata*, Bosquet (Entom. Tert., p. 71, t. 3, f. 7), but is narrower, and more tapering and acute.

One specimen from the Clay with green sand (No. 29, of Mr. Prestwich's section¹) at Alum Bay, Isle of Wight, represents this species.

[B. *Oblong forms of CYTHERE*, proper.]

No. 8. CYTHERE KOSTELENSIS (?), *Reuss sp.* PLATE VI, figs. 14 a, 14 b.

CYPRIDINA KOSTELENSIS, *Reuss*. Haidinger's Abhandl., iii, p. 68, t. 9, fig. 22.

CYTHERE KOSTELENSIS, *Jones*. Quart. Journ. Geol. Soc., x, p. 161, t. 3, fig. 10.

INCH.

Length, $\frac{1}{40}$

Middle Tertiary: Austria, &c.

Lower Eocene: Woolwich, Kent.

¹ See above, p. 27.

Carapace small, oblong, depressed, flattest anteriorly; obliquely rounded in front, semicircular behind; upper and lower margins slightly incurved; extremities bearing slightly raised marginal rims: *surface* roughened with irregular punctations.

Dorsal aspect elongate-acute-ovate; *end-view* suboval.

Two specimens of this minute species (which agrees with Reuss's *C. Kostelensis*, except in the condition of the posterior margin) were found by Mr. Rosser in the Woolwich beds (Lower Eocene). *C. Kostelensis* occurs in the Leitha-Kalk of Moravia and Austria, in clay-beds near Vienna, in the salt-rock of Galicia, and in Tertiary beds of Upper Silesia.

No. 9. CYTHERE CONCINNA, *spec. nov.* PLATE IV, figs. 7 *a*—7 *f*.

INCH.

Length, $\frac{1}{20}$

Pleistocene: Bridlington, Yorkshire.

Carapace triangular-oblong; rounded in front, obliquely truncate behind; straight on the ventral, and obtusely angular on the dorsal border, the anterior hinge forming a low blunt angle: *surface* of valves depressed; marked by three low tubercles (one central and two posterior), minutely punctated, and perforated at points as wide apart as the distance of 3—4 of the superficial pits (fig. 7 *f*); the valves have also a slightly elevated anterior margin, and are sometimes beset with obscure scattered tubercles, forming an irregular rugosity of the surface.

Dorsal aspect narrow-oblong with rounded ends; *end-view* narrow-ovate.

Cythere concinna was found in some numbers—together with *Cythere* (*Cytheridea*) *Sorbyana*—by Mr. H. C. Sorby in the Bridlington Crag, at Bridlington, Yorkshire.

No. 10. CYTHERE WOODIANA, *spec. nov.* PLATE III, figs. 2 *a*—2 *g*.

INCH.

Length, $\frac{1}{18}$

Pliocene: Suffolk.

Carapace oblong, rounded obliquely at the extremities, upper and lower borders nearly straight; valves depressed anteriorly, most convex just behind the centre and towards the ventral border; right valve markedly narrower than the left; its hinge-line outstanding, being notched fore and aft: *surface* ornamented with small well-marked sub-hexagonal or circular pits, arranged in longitudinal lines, except on the anterior portion of the valves, where the pitting affects transverse and concentric lines:

punctuation very fine, and lying in depressed lines or striæ in young individuals; coarser and less distinctly linear, and somewhat transverse, in old specimens. A variety, white and smooth, almost destitute of punctations, or rather with exceedingly minute linear pittings, is common; and some individuals are partially punctated. The *hinge* is strongly developed.

Dorsal aspect elongate-acute-ovate; *end-view* suborbicular.

This species appears to belong to the same type as *C. Jurinei*, Münster, and its varieties, figured and described by Bosquet ('Descript. Entom. Tert.,' p. 56, t. 2, figs. 9, 10), *C. Meyni*, Reuss ('Zeitsch. Deut. geol. Ges.,' viii, p. 279, t. 10, fig. 5), and *Bairdia* (?) *semipunctata*, Bornemann (*Ibid.*, vii, p. 359, t. 21, fig. 1). I have met with a very similar form in Tertiary sand from Bordeaux.

Cythere Woodiana occurs very plentifully, in different stages of growth, and with several variations as to intensity of punctuation, in the Crag of Suffolk,—and bears the name of Mr. Searles N. Wood, who has for many years, and with great success, collected, studied, and elucidated the fossils of the Crag. To Mr. Wood I am indebted for the majority of the specimens from the Crag described in this Monograph.

No. 11. *CY THERE LAQUEATA*, *spec. nov.* Plate III, figs. 3 *a*—3 *h*.

INCH.

Length, $\frac{1}{18}$

Pleistocene: Red Crag, Essex.

Pliocene: Crag, Suffolk.

Carapace broad-ovate-oblong, rounded somewhat obliquely in front, contracted and rounded behind; extremities denticulate, depressed; dorsal margin slightly arched: ventral margin somewhat sinuous: *valves* nearly equal; surface coarsely punctate with large subquadrate pits: *hinges* very strong.

Dorsal profile broadly acute-ovate; *end-view* subovate.

In a translucent young valve the surface is smooth, but a distinct coarse reticulation is seen by the opacity of the parietes of its meshes in the tissue of the valve: these meshes appear to be subsequently represented by the superficial pittings.

Cythere laqueata is rather rare in the Crag of Sutton, &c., in Suffolk, where it occurs with *C. Woodiana*, *C. Macropora*, &c. It occurs also in the Upper or Red Crag at Walton-on-Naze, Essex.

No. 12. *CY THERE DICTYOSIGMA*, *spec. nov.*

INCH.

Length, $\frac{1}{24}$

Pliocene: Suffolk.

Carapace oblong; extremities obliquely rounded: *valves* thick, somewhat depressed, showing more or less distinctly the central and two posterior tubercles; surface finely reticulated, the meshes small, angular, and deep, the parietes of the meshes thick, squared, and strong; on the ventral slopes the longitudinal parietes of the reticulation are the most distinct (as is usual in reticulated carapaces), on the rest of the surface the reticulation is irregular or labyrinthine.

Dorsal aspect narrow-obtuse-ovate; *end-view* subovate.

Cythere Dictyosigma somewhat resembles *C. bidentata*, Bosquet ('Entom. Tert.,' p. 72, t. 3, fig. 9), from Dax. It is not uncommon in the Crag of Suffolk; but the specimens were overlooked when the plates were being prepared.

No. 13. *CYTHERE LACUNOSA*, *spec. nov.* Plate III, figs. 5 *a*, 5 *b*.

INCH.

Length, $\frac{1}{27}$

Recent: Norway.

Pliocene: Suffolk.

Carapace oblong, slightly tapering backwards; rounded obliquely at the extremities; posterior lobe narrow and thickened; dorsal and ventral edges nearly straight; valves somewhat depressed, with the centre sunken and occupied by a large tubercle; margins depressed and thickened: *surface* of valves marked by 3—4 concentric riblets towards the anterior margin, one of which is continued along the dorsal part of the valve; parallel with and inside this slight dorsal ridge is a row of coarse, quadrangular, shallow pits; an obscure punctation and scattered pimples occupy the middle part of the valves, especially around the great central tubercle.

Dorsal aspect irregular-narrow-oblong.

This species occurs in the Crag of Suffolk, where it is rather rare. It is plentiful in the deeply dredged shell- and sponge-sand from the Norway coast, with which I have been favoured by Messrs. MacAndrew and Barrett.

No. 14. *CYTHERE SCABROPAPULOSA*, *spec. nov.* Plate V, fig. 16.

INCH.

Length, $\frac{1}{29}$

Middle Eocene: Bracklesham.

Carapace sub-oblong; tapering backwards, and ending in a flattened, angular, denticulate, posterior lobe; anterior extremity obliquely rounded, bordered by a thickened and raised margin: *surface* of valves thickly beset with low and rounded tubercles; anterior hinge marked by a strong tubercle.

Dorsal aspect elongate-subovate.

This species closely resembles *C. scabra*, Münster, figured and described by Bosquet, 'Descrip. Entom. Tert.,' p. 103, t. 5, fig. 7; but, instead of smooth tubercles, the latter has ragged lamellar tubercles. Such exogenous growths as tubercles and spines are subject to great variations of development, and must be used with caution for specific characters; still I prefer to regard the form under notice as distinct from *C. scabra*.

Cythere scabropapulosa occurs at Bracklesham, and is rare. *C. scabra*, according to Bosquet, belongs to the Subapennine deposits of the South of France, and the Miocene beds of Dax; Roemer derived it from the North-west of Germany (Osnabruck), and from Bordeaux.

No. 15. CYTHERE COSTELLATA, *Roemer, sp.* Plate V, fig. 11.

CYTHERINA COSTELLATA, *Roemer.* Neues Jahrb. f. Min., &c., 1838, p. 517, t. 6, fig. 24.

CYTHERE COSTELLATA, *Bosquet.* Mém. Couron. Acad. Belg., xxiv, p. 58, t. 2, fig. 11.

INCH.

Length, $\frac{1}{8}$

Middle Eocene: England and France.

Carapace ovato-oblong; rounded before, narrow behind; dorsal border straight, ventral slightly convex: *valves* most convex posterior to the centre, depressed anteriorly; front and hind margins more or less denticulate; surface covered by several narrow, rounded, longitudinal, slightly sinuous ribs, placed side by side (10 or 11 in my specimens, 7 or 8 in M. Bosquet's, and "about six" in M. Roemer's).

Dorsal aspect elongate-acute-ovate; *end-view* ovate.

A slight difference in the number of the superficial riblets exists amongst the specimens figured and described,—as above noticed; and there also appears to be a somewhat greater convexity in Roemer's 6-ribbed form than in Bosquet's 7- or 8-ribbed specimens, and in the latter than in my 10-ribbed specimens.

Bosquet enumerates several localities for *C. costellata* in the "Sables moyens," the "Calcaire grossier," and in the "Sables inférieurs" of France. Roemer's specimens also came from the Paris Tertiaries. In England I have only met with this species in the sandy blue clay at Bracklesham, where a single specimen (perfect carapace) was obtained.

No. 16. CYTHERE PLICATA, *Münster.* Plate IV, fig. 16; Pl. V, figs. 8 *a*—8 *d*;
Pl. V, fig. 17.

CY THERE PLICATA, *Münster*. Jahrb. f. Min., &c., 1830, p. 63; and Neues Jahrb., &c. 1835, p. 446.

CY THERINA PLICATA, *Roemer*. Neues Jahrb. f. Min., &c., 1838, p. 518, t. 6, fig. 26.

CYPRIDINA PLICATA, *Reuss*. Haidinger's Abhandl., iii, p. 43, t. 10, fig. 21.

— LATICOSTATA, *Ib.* Haidinger's Abhandl., iii, p. 87, t. 11, fig. 13. [*C. plicata*, var.]

CY THERE PLICATA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 60, t. 2, fig. 13.

— (CY THEREIS) PLICATA, *Jones*. Quart. Journ. Geol. Soc., x, p. 162, t. 2, fig. 13.

INCH.
Length, $\frac{1}{25}$

Middle Eocene: Isle of Wight, and Hampshire.
Upper and Middle Eocene: Europe.

Carapace ovato-oblong; anteriorly oblique, with the antero-ventral angle rounded; posteriorly narrower and obliquely rounded; dorsal margin straight; ventral margin convex or somewhat sinuate: *valves* most convex at the posterior third; bearing three raised longitudinal ridges,—one on either side of, and parallel with, the median line of the valve (the ventral one the most convex and gently curving downwards, the other weaker and sinuous), and another (the third) ridge occupying the dorsal part of the valve, shorter than the others and curved, its most convex central portion more or less projecting over the dorsal edge; the ventral portion of the valve suddenly slopes inwards and downwards from the summit of the ventral ridge, so as to form a blunt keel to the closed carapace; front and hind margins more or less denticulate: *surface* of the valves usually ornamented with faint longitudinal wrinkles and obscure pittings and reticulations on and between the ridges.

Dorsal profile elongate-subovate, with angular ends; *end-view* broad-irregular-ovate, modified by the lateral ridges.

This species, like *C. triplicata* of the Chalk, is one of the passage-forms between *Cythere* proper and *Cythereis*.

Var. *laticosta* (*Reuss, Loc. cit.*), from the Barton Clay of Hampshire, is decidedly identical with the form (from the same deposit) figured at pl. 5, fig. 8; and is merely a more ovate, shorter, plumper, and more strongly ribbed variety of *C. plicata*.

This species has been found in the Miocene deposits of Dax, and in the Eocene of France, Belgium, North-western Germany, Bohemia, Austria, and Moravia. It occurs abundantly in the white Tertiary sands and in an Oyster-band at Colwell Bay, Isle of Wight; also in the clays at Barton, Highcliff, and Bracklesham, in Hampshire.

The specimens from Colwell are opaque, white, and fragile; those from the Hampshire clays are brown, tough, and somewhat translucent.

No. 17. CY THERE SCROBICULOPLICATA, *spec. nov.* Plate VI, figs. 4, 6 a—6 d.

INCH.
Length, $\frac{1}{25}$

Lower Eocene: London.

Carapace ovato-oblong; extremities obliquely rounded; posterior end narrowest and most oblique; ventral margin curved from its centre towards the posterior extremity; dorsal margin straight: *surface* of the valves raised into three obscure longitudinal ridges, holding the same relative position as the ridges on *C. plicata*; valves covered with a coarse reticulation of sub-quadrangular pits, arranged somewhat concentrically.

Dorsal aspect acute-ovate; *end-view* sub-ovate.

This species differs from *C. scrobiculata*, Münster, in the ridged character of the valves, in being more oblong, in having the longitudinal parietes of the pits on the central part of the valves more developed than the transverse, and in the absence of the faint semicircular riblets which traverse the anterior portion of *C. scrobiculata*.

The latter occurs in the Eocene deposits of France and Belgium, and in Tertiary deposits of the North-west of Germany; also at Dax in France, and near Parma in Italy.

Cythere scrobiculoplicata is not rare in the London Clay of Copenhagen Fields, London; and Mr. Wetherell has favoured me with a fine specimen from the London Clay of Finchley, near London.

Var. RECTA, *nov.* Plate VI, fig. 9.

INCH.

Length, $\frac{1}{3}$

Middle Eocene: East Woodhay, Hampshire.

Carapace smaller than that of *C. scrobiculoplicata*, triangularly ovate, obliquely rounded in front, and tapering symmetrically towards the rounded posterior extremity; the anterior portion of the valves not reticulated, but obscurely punctate, and bordered by a narrow, raised, marginal rim; the rest of the surface is ridged and reticulated on the plan of *C. scrobiculoplicata*.

A single valve occurred in some blue clay, from East Woodhay, Hampshire, probably belonging to the Bagshot and Bracklesham series.

No. 18. CYTHERE ANGULATOPORA, *Reuss, sp.* Plate IV, figs. 17, 18 *a*, 18 *b*; and Pl. VI, fig. 18.

CYPRIDINA ANGULATOPORA, *Reuss.* Haidinger's Abhandl., iii, p. 86, t. 10, fig. 32.

CYTHERE ANGULATOPORA, *Bosquet.* Mém. Couron. Acad. Belg., xxiv, p. 68, t. 3, fig. 5.

— (CYTHEREIS) ANGULATOPORA, *Jones.* Quart. Journ. Geol. Soc., p. 162, t. 3, fig. 12.

INCH.

Length, $\frac{1}{25}$ to $\frac{1}{18}$

Middle Eocene: England; France; Belgium.

Carapace oblong; obliquely rounded in front, rounded behind; dorsal and ventral edges nearly straight: *surface* of valves ornamented with a bold reticulation of large square meshes, the longitudinal parietes being strongly developed; a somewhat concentric arrangement of the meshes occurs at the central tubercle or place of the lucid spots. [The markings of the surface are not drawn sufficiently distinct in fig. 17.]

Dorsal aspect elongate-ovate, with the ends produced and truncate; *end-view* broadly sub-ovate.

When some of the longitudinal parietes of the reticulation are more strongly developed than the others, this form approaches *C. plicatula* and *C. Gracilicosta*, Reuss.

Cythere Angulatopora is not uncommon in the Tertiary sands and Oyster-band of Colwell Bay, Isle of Wight.

M. Bosquet has obtained this species from the "Calcaire grossier" and "Sables moyens" of France; and Dr. Reuss's specimens came from the "Calcaire grossier" of Epernay. I have found it also in a Middle Eocene deposit from Ghent, Belgium.

No. 19. CYTHERE MACROPORA, *Bosquet*. Plate III, figs. 9 a—9 e.

CYTHERE MACROPORA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 97, t. 5, fig. 2.

INCH.

Length, $\frac{1}{17}$

Pliocene: Suffolk.

Middle Eocene: France.

Carapace oblong; slightly tapering and rounded behind; obliquely rounded in front; somewhat incurved on the upper and lower borders: *valves* thick, denticulate at the extremities, most convex posteriorly, anterior portion raised by the great central tubercle; ventral and dorsal portions sloping suddenly inwards, leaving an oblong superficial plateau, the posterior angles of which are defined by the two posterior tubercles: *surface* covered by a coarse reticulation of large quadrangular pits, separated by strong squared parietes; the pits on the dorsal portion of the plateau forming two curved longitudinal series, those on the ventral portion arranged in three or four obliquely transverse rows; the ventral and dorsal slopes also coarsely reticulated.

Dorsal aspect irregular oblong, with produced ends; *end-view* sub-quadrangular.

The very young form (fig. 9 e) exhibits the three tubercles (central and two posterior) very distinctly.

Cythere Macropora is rather rare in the Crag of Sutton and elsewhere in Suffolk. According to M. Bosquet, this species occurs very sparingly in the "Grès de Fontainebleau" and the "Sables moyens" of France.

No. 20. CYTHERE TRACHYPORA, *spec. nov.* Plate III, figs. 9 *f*—9 *i*.

INCH.

Length, $\frac{1}{25}$

Recent: Norway.

Pliocene: Suffolk.

Carapace sub-quadrangular; somewhat tapering posteriorly; rounded obliquely in front; contracted behind: *valves* showing the three tubercles, the two posterior of which are prolonged forwards as faint ridges: *surface* roughly reticulato-punctate.

Dorsal aspect compressed-subovate, with produced ends.

Cythere Trachypora differs from *C. Macropora* (with which at first I associated it as a dwarfed variety) in being smaller, with a more depressed and uneven surface, on which the posterior tubercles are more apparent; also in being less angular, and in having its ornamentation less distinctly sculptured. It appears to stand between *C. Macropora* and *C. Hebertiana*, Bosquet.

This species is frequent in the Crag of Suffolk. It occurs also recent on the coast of Norway, where it was dredged by MM. MacAndrew and Barrett. I believe that I also have had it from the Red Crag of Walton, Essex.

No. 21. CYTHERE RETIFASTIGATA, *spec. nov.* Plate III, fig. 7.

INCH.

Length, $\frac{1}{25}$

Pliocene: Suffolk.

Carapace-valve oblong, tapering backwards, rounded at the ends; raised by three obscure, longitudinal, parallel ridges into an oblong raised plateau, with sudden slopes towards the margins: *surface* marked with a strong punctation; the pits circular and regular in their arrangement, coarsest anteriorly.

A few specimens only of the valves of this species have as yet occurred in my examination of the Suffolk Crag.

No. 22. CYTHERE SPHÆRULOLINEATA, *spec. nov.* Plate III, fig. 6.

INCH.

Length, $\frac{1}{24}$

Pliocene: Suffolk.

Carapace-valve oblong; obliquely rounded in front, almost truncate behind; most

convex posteriorly and ventrally; sloping suddenly towards the borders, slope steepest on the ventral border: *surface* ornamented with a large central tubercle and two thin longitudinal, parallel, beaded ridges; one of which is placed at the edge of the dorsal, the other at that of the ventral slope; and both are connected by a similar, short, transverse ridge along the edge of the posterior slope; the area between and outside the ridges is faintly punctate.

Dorsal aspect elongate-acute-ovate, nearly cuneiform; *end-view* sub-ovate.

I have met with only three specimens in the Crag of Suffolk.

Sub-genus—CYTHEREIS,¹ Jones.

Animal probably a *Cythere*. *Carapace* oblong; variously ornamented with reticulations, tubercles, spines, and ridges: the bar and furrow of the hinge are nearly or quite obsolete; but the anterior and posterior hinges are well defined, and isolated, marking definite angles in the outline of the carapace-valves: the central and posterior tubercles on the surface of each valve are strongly marked, passing into more or less developed longitudinal ridges, the ventral one of which is always raised, and often greatly produced, giving a flat ventral surface and a somewhat triangular end-view to the closed carapace.

No. 1. CYTHEREIS SENILIS, *spec. nov.* Plate III, figs. 8 *a*, 8 *b*.

INCH.

Length, $\frac{1}{29}$

Pliocene: Suffolk.

Carapace-valve oblong, rounded in front, truncate and denticulate behind; margins thickened; surface bearing three disconnected, squared ridges; the one towards the ventral border running the length of the raised plateau of the surface and curving round its anterior portion; the central ridge shorter and nearly straight; the dorsal one shortest and oblique; exposed edge of the ridges beaded, or rather marked with lozenge-shaped spots, which possibly indicate that the ridges were once higher and perforate, as in *Cythereis fistulosa*, *C. runcinata*, and *C. prava*, Baird,—the lozenge-markings being perhaps the bases of the minute interstitial pillars of the raised perforate edges of the ridges.

¹ For synonyms and greater detail of description, see 'Monog. Entom. Cret.,' 1849, p. 14. Since 1849, *Cythereis* has been in some cases erected into a genus, in others merged into *Cythere* proper, and rarely accepted as a sub-genus. See Note above, p. 7.

Cythere (Cythereis) senilis is very nearly allied to *C. fistulosa* and *C. runcinata*, Baird:¹ it is represented by one specimen only from the Crag of Suffolk.

No. 2. *CY THEREIS BOWERBANKIANA*, *spec. nov.* Plate VI, figs. 7, 8.

INCH.

Length, $\frac{1}{19}$

Eocene: London.

Carapace-valves oblong, obliquely rounded in front, contracted behind, most convex posteriorly and ventrally; margins of the extremities depressed, more or less coarsely denticulate; ventral portion strongly ridged and coarsely spined: *surface* of valves coarsely and irregularly reticulate; bearing coarse irregular spines along the dorsal portion, and scattered short spines or tubercles about the central portion; both spines and reticulations variable in their development.

Dorsal profile sagittate with jagged outline; *end-view* triangular.

A few specimens of single valves of this species occurred in the London Clay of the Copenhagen Fields at the Great Northern Railway cutting; and Mr. W. K. Parker has lately favoured me with two fine perfect carapaces from the London Clay of Wimbledon Common.

I associate with this characteristic and remarkably fine species the name of one of the most successful and distinguished of the geologists who have studied the natural history of the London Clay, and of the British fossiliferous deposits generally.

No. 3. *CY THEREIS HORRESCENS*, *Bosquet*. Plate V, figs. 9, 17 *a*, 17 *b*.

CY THERE HORRESCENS, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 116, t. 6, fig. 5.

? — *LATIDENTATA*, *Bornemann*. Zeitsch. Deutsch. geol. Ges., vii, p. 366, t. 21, fig. 6.

INCH.

Length, $\frac{1}{25}$

Recent: Norway.

Eocene: England; France.

Carapace-valves oblong, rounded at the ends, which are more or less coarsely denticulate; ventral ridge coarsely spined: *surface* beset with scattered blunt spines² and

¹ 'Proceed. Zool. Soc. London,' 1850, p. 256: *Annulosa*, t. 18, figs. 1—3, 7—9. Possibly these are varieties of one species.

² In fig. 9 the dorsal portion of the valve ought to bear blunt spines, not tubercles.

tubercles, varying (like the spines of the ventral ridge and the extremities) in their development in different individuals.

Dorsal profile sagittate and jagged; *end-view* triangular.

Cythere (*Cythereis*) *horrescens* occurs both at Barton and Bracklesham, in the Tertiary clays. According to M. Bosquet, this species and its varieties are found in the "Sables moyens," the "Calcaire grossier," and the "Sables glauconifères" of France.

I have found two specimens of this fine species in the sand dredged by Messrs. MacAndrew and Barrett on the Norway Coast.

No. 4. CYTHEREIS CERATOPTERA, *Bosquet*. Plate IV, fig. 1.

CYTHERE CERATOPTERA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 114, t. 5, fig. 2.

INCH.

Length, $\frac{1}{18}$

Pliocene: Suffolk.

Upper and Middle Eocene: Belgium and France.

Carapace sub-oblong, tapering posteriorly; smooth; strongly and coarsely spined on the anterior, dorsal, and posterior margins, and along the ventral ridge, which is very much produced.

Dorsal aspect sagittate, with the edges jagged; *end-view* triangular.

From the Crag of Sutton, Suffolk, where it appears to be rare. Bosquet obtained it in Belgium from the Basele Clay near Rupelmonde, and from the Nucula-bed at Berg, near Klein-Spawen; and in France from Tertiary sands near Etampes.

No. 5. CYTHEREIS CORNUTA, *Roemer*, *sp.* Plate IV, fig. 19; Pl. V, figs. 15 *a*, 15 *b*.

CYTHERINA CORNUTA, *Roemer*. Neues Jahrb. f. Min., &c., p. 518, t. 6, fig. 31.

— — *Reuss*. Verstein. Böhm. Kreid., p. 105, t. 24, fig. 20.

CYTHERE CORNUTA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 117, t. 6, fig. 4.

— — *Reuss*. Zeitsch. Deutsch. geol. Ges., vii, p. 282, t. 10, fig. 10.

— (CYTHEREIS) ALATA (?), *Bosq., Jones*, Monog. Entom. Cret., p. 21, t. 5, fig. 14.

INCH.

Length, $\frac{1}{28}$

Middle Eocene: England and Europe.

Cretaceous: England and Europe.

Carapace sub-oblong; oblique and somewhat rounded in front; posterior lobe sub-angular; extremities denticulate; surface smooth, occasionally marked with one or

more obscure tubercles near the centre, and with one, and sometimes two slight semi-lunar ridges near the dorsal margin; ventral ridge strongly produced, narrow, and smooth.

Dorsal aspect sagittate; *end-view* triangular.

Cythere (*Cythereis*) *cornuta* has many near allies. M. Bosquet has separated (under the name of *C. calcarata*) the form figured by Reuss ('Haid. Abh.,' iii, t. 10, fig. 18) as *C. cornuta* [and subsequently referred by him—fig. 18 *b* to *C. ceratoptera*, Bosquet, and fig. 18 *a* to *C. coronata*, Roemer], because it is spiny on the dorsal and ventral borders, though Roemer's figure of *C. cornuta* appears to indicate a tendency to spinosity on the ventral ridges. *C. ceratoptera* is of the same typical form, but presenting spines or serrations at every margin. Nor is there much to distinguish *C. serrulata*, Bosquet, from *C. cornuta*; and the cretaceous form from the English Chalk which I referred to Bosquet's *C. alata* has, I believe, no distinction from the *C. cornuta* of Colwell and Bracklesham (pl. 4, fig. 19, and pl. 5, fig. 15), except in its somewhat greater squareness and convexity, and the possession of a few more spines.

The specimens of *C. cornuta* here figured and described are from the Tertiary sands of Colwell Bay, Isle of Wight, and from the Tertiary blue clay of Bracklesham Bay, Hampshire.

No. 6. CYTHEREIS, *sp. indeterminata*. Plate VI, fig. 17.

Lower Eocene: Thanet Sands, Kent.

This fragment from the antero-dorsal angle of the left valve of a *Cythereis*, indicating a ridged valve, possibly resembling *C. quadrilatera* of the Chalk, occurred in some of the Thanet Sand from Pegwell Bay, near Ramsgate.

As, from the nature of the deposit, calcareous organisms of any kind are rare,¹ and as this is the only indication of an Entomostrakon met with, though I have examined several specimens of the Thanet Sands from Mr. Prestwich's cabinet, I have figured the fragment in this place, as at least an interesting, if not an instructive specimen.

Sub-genus—CYTHERIDEA, *Bosquet*,² *genus*. *Cytherinæ* et *Cytheres*, Auctorum.

Animal a Cythere. *Carapace* somewhat triangular, or triangularly ovate, the widest part (vertically) being at the anterior third, beneath the anterior hinge; surface usually pitted, occasionally reticulated: *hinge-margin* of one valve (right) marked by a series

¹ 'Quart. Journ. Geol. Soc.,' vol. viii, p. 245.

² 'Descript. Entom. foss. Terr. Tert.,' p. 37.

of small tubercles, forming a knurling or fine crenulation on this edge, somewhat like the hinge-teeth of *Nucula*, the other valve having corresponding pits on its dorsal margin: these rows of small hinge-teeth are either continuous along the hinge-margin (as in Dana's figure of *Cythere Americana*), or are discontinued (to a greater or less extent) in the central part and form isolated groups at the anterior and posterior angles of the dorsal margin; whilst the intermediate portion of the margin has still smaller tubercles on the *left*, and corresponding pittings on the right valve¹ (this is also the case in *Cyprideis* [*Cythere?*] *torosa*): ventral margins somewhat incurved.

No. 1. CYTHERIDEA MULLERI, *Münster, sp.* Plate V, figs. 4 *a*—4 *c*, and 5; Pl. VI, figs. 10 *a*, 10 *b*, and 11—13.

CYTHERE MULLERI, *Münster.* Jahrb. f. Min., &c., 1830, p. 62; and Neues Jahrb., &c., 1835, p. 446.

CYTHERINA MULLERI, *Roemer.* *Ibid.*, 1838, p. 516, t. 6, fig. 6.

— — *Reuss.* Haidinger's Abhandl., iii, p. 55, t. 8, fig. 21.

— INTERMEDIA, *Reuss.* *Ibid.*, p. 86, t. 11, fig. 12. [*C. Mulleri*, var.]

CYTHERIDEA MULLERI, *Bosquet.* Mém. Couron. Acad. Belg., xxiv, p. 39, t. 2, fig. 4.

— — *Jones.* Quart. Journ. Geol. Soc., x, p. 160, t. 3, fig. 7; and Mem. Geol. Survey, 1856, p. 158, t. 7, fig. 28.

INCH.

Length, $\frac{1}{20}$

Recent: Holland; Australia.

Tertiary: England; Europe; Australia?

Carapace ovately triangular, rounded anteriorly, obliquely pointed behind; dorsal margin arched; ventral margin straight or slightly incurved; anterior margin spinous: *surface* coarsely punctate; the pits generally associated with semicircular furrows on the fore part of the valves, and with longitudinal furrows on the ventral part; on the posterior half of the valve the pittings follow transverse sunken lines, parallel with the transverse sulcus which is more or less apparent on the centre of each valve, at the place of the lucid spots.

Anterior to this median furrow frequently occurs a tubercle (pl. 6, fig. 11), or at least a marked elevation of the surface (pl. 6, fig. 10 *a*). In some specimens from the Barton Clay, however, the furrow and tubercle are absent (pl. 5, fig. 4 *a*).

Lucid spots small, four, arranged in a transverse row (System c, see page 6).

Dorsal profile narrow oblong, very slightly incurved at the sides, and obtusely angular at the ends; *end-view* ovate.

¹ This form of hingement is also apparent in Zenker's figure of the hinge-line of the species which he has described as *Cythere viridis*, 'Archiv f. Natur.,' *loc. cit.* t. 4, fig. 10.

Generally the English specimens slightly differ from M. Bosquet's figures in almost wholly wanting the longitudinal parallel furrows on the ventral surface, which are continued transversely and concentrically across the anterior half of the valve; faint traces only of the concentric furrows being occasionally seen, though irregular transverse furrows, full of pittings, are conspicuous in old specimens. One such transverse furrow, immediately posterior to the lucid spots, near the centre of the valve, is nearly always present, even in young specimens. I have not met with individuals retaining the setæ of the surface.

Cythere (Cytheridea) Mulleri occurs throughout the Tertiary formations of Europe; being found in Austria, Bohemia, Hesse, Westphalia, France, Belgium, and the Netherlands, in the *Eocene*; in Touraine (*Miocene*); and in the Netherlands (*Pliocene*). In England it occurs abundantly in many of the shales of the Hempstead series, at Hempstead Cliff, Isle of Wight; and one specimen was met with in a green shale of the Osborne series, at Cliff End, Isle of Wight; it is not rare (as the var. *intermedia*) in the Barton Clay of Hampshire; and the clay with oysters from Colwell Bay, Isle of Wight, yielded three or four specimens; these deposits are of the Upper Eocene group: and in the Woolwich and Reading series (Lower Eocene) it has been found at Clay Hill,¹ near Newbury, Berks, and is abundant at Woolwich, Kent. This species also occurs in a tertiary blue clay, given to me as having been brought from Australia; and I have a small recent specimen from the Australian seas. M. Bosquet also records this species as living in the Zuyderzee, Holland.

M. Reuss has figured under the name of *Cytherina intermedia* a form which he derived from the Barton Clay of Hampshire: this is evidently identical with the unfurrowed variety (pl. 5, fig. 4) from the same deposit. M. Reuss regards it as intermediate between *C. Mulleri*, Münster, and *C. seminulum*, Reuss (*loc. cit.*, p. 59, t. 9, figs. 5—8), which latter in all its varieties appears to me to belong to Von Münster's species.

Var. **TOROSA**, *Jones*. Plate VI, fig. 12.

CY THERE (CYTHERIDEA) MULLERI, var. TOROSA, *Jones*. Quart. Journ. Geol. Soc., x, p. 161, t. 3, fig. 8; and Memoirs Geol. Survey, 1856, p. 158, t. 7, fig. 27.

INCH.

Length, $\frac{1}{30}$

Upper Eocene: Hempstead Cliff.

Lower Eocene: Woolwich.

This variety differs from the typical *C. Mulleri* in being generally smaller (although sometimes as long, though not so high as the type), and in having the surface of the

¹ In the sandy clay-beds with *Ostræa Bellovacina*.

valves raised up into irregular lumps or bosses. Of these knobs, which are often but ill defined, sometimes seven can be counted on one valve. The spots most usually occupied, when the bosses are but few, are the posterior part of the valve and especially the central part immediately in advance of the sulcus and the place of the lucid spots. In its general form *C. torosa* resembles that variety of *C. Mulleri* in which the posterior extremity is contracted and acuminate (var. *acuminata*, Bosquet).

This torose variety was found plentifully by Mr. Rosser in the same beds of the Woolwich series as yielded the typical *C. Mulleri*. It occurs also abundantly in some of the shales of the Hempstead series, in Hempstead Cliff, Isle of Wight.

NO. 2. CYTHERIDEA DEBILIS, *spec. nov.* Plate V, fig. 5; Pl. VI, fig. 13.

INCH.

Length, $\frac{1}{42}$

Recent: Norway.

Upper Eocene: Isle of Wight.

This is a small form, nearly resembling *C. Mulleri* in outline, but much smaller, and more obtuse; not so acute posteriorly as *C. Mulleri*, var. *torosa*; often destitute of the median impression, and bearing a weakly marked punctation. It is sometimes, however, larger than usual, and more strongly punctate.

Cythere (*Cytheridea*) *debilis* occurs with the typical *C. Mulleri* in numbers in an Oyster-band, a Nucula-bed,¹ and other deposits, of the Upper Eocene series at Colwell Bay, Isle of Wight. A similar form occurs recent on the coast of Norway.

NO. 3. CYTHERIDEA PINGUIS, *spec. nov.* Plate II, figs. 4 a—4 h.

INCH.

Length, $\frac{1}{23}$

Pliocene: Suffolk.

Carapace thick, ovate-triangular; sub-cylindrical when young; lowest behind; highest at the anterior third, where it is also somewhat compressed; dorsal border more or less arched; ventral border straight, with its edge somewhat inturned: *surface* of valves in the young state finely punctate and beset with scattered papillæ (fig. 4 g), in older individuals coarsely punctate (fig. 4 h): *hinge* well developed.

Dorsal aspect sub-oblong; *end-view* sub-orbicular.

Cythere (*Cytheridea*) *pinguis* is nearly related to *C. Mulleri* on one side and

¹ The specimens from this bed were kindly communicated to me by my friend Mr. Harris, of Charing.

C. papillosa, Bosquet, on the other; and there are several allied forms figured by Reuss (Haidinger's Abhandl., iii, pl. 8), but they do not appear to be specifically identical. The species also figured and described by M. Bosquet as *Bairdia punctatella* (Descript. Entom. Tert. p. 75, tab. 1, fig. 10) is not unlike *C. pinguis*, although smaller; and, like several other species figured on the same plate, is decidedly not a *Bairdia*.

No. 4. CYTHERIDEA SORBYANA, *spec. nov.* Plate IV, figs. 6 a—6 e.

INCH.

Length, $\frac{1}{18}$

Pleistocene: Bridlington.

Carapace irregularly triangular and approaching a pentagonal form,—of which the ventral border makes a long straight side, the dorsal two shorter straight sides, oblique to each other and to the remaining sides, whilst lastly the anterior and posterior extremities complete the pentagon,—the former with an obliquely rounded, and the latter with an oblique straight border; the junction of the ventral and posterior borders forms an angle very slightly rounded; the anterior border is strongly spined: *surface* of the valves marked towards the margins with concentric ridges, following the outline of the valve, and connected by short oblique ridges or wrinkles, which are continued over the middle of the valve, where the long ridges become nearly obsolete, forming with the others a strong angular reticulation, sometimes closing up and becoming granular in the centre of the surface; the long ridges are marked at short regular intervals with trumpet-shaped perforations¹ (fig. 6 e). *Lucid spots* four in one row (System c).

Dorsal aspect lanceolate; *anterior*, acute-oval.

Found by Mr. H. C. Sorby, F.G.S. (to whom, as an ardent and distinguished geologist, I have much pleasure in dedicating this peculiar species), in the Pleistocene deposit known as the Bridlington Crag, at Bridlington, Yorkshire.

No. 5. CYTHERIDEA PERFORATA, *Roemer, sp.* Plate IV, figs. 14 a—14 e.

CYTHERINA PERFORATA, *Roemer*. Neues Jahrb. f. Min., &c., 1838, p. 516, t. 6, fig. 11.

CYTHERE HILSEANA,² *Jones* (non *Roemer*). Monog. Entom. Cret., p. 10, t. 1, fig. 1.

¹ Seen under the microscope by reflected light, these perforations, being visible in the translucent substance of the valve, appear on that side of the convex valve which is away from the direct rays of light like out-standing blunt spines. This phenomenon occurs also in the punctated and perforated valves of other species, when their substance is translucent

² M. Bosquet, having had the opportunity of examining both Roemer's *C. Hilseana* and my specimens which I referred to that species, has determined that they belong to distinct species.

CYTHERIDEA JONESIANA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 38; and Mém.

Comm. Carte Géol. Neerl., ii, p. 64, t. 8, fig. 5.

— — — *Reuss*. Denksch. Akad. Wiss. Wien., vii, p. 141.

BAIRDIA PERFORATA, *Bosquet*. Mém. Couron. Acad. Belg., xxiv, p. 24, t. 1, fig. 8.

INCH.

Length, $\frac{1}{25}$

Tertiary: England; Europe.

Cretaceous: England; Europe.

Carapace sub-triangular or triangular-ovate; most convex at or just behind the centre of the ventral portion; ventral border straight, or faintly convex; dorsal border strongly arched and somewhat angular at the anterior hinge; anterior end broad and obliquely rounded; posterior tapering and obtuse; right valve much narrower than the left, its hinge-line oblique and terminating at the anterior hinge with a distinct angle; surface of the valves finely punctate and perforate, the perforations, obliquely seen in the translucent substance of the carapace, often appearing as projecting spines or hairs (see Note, p. 44).

Dorsal aspect more or less lanceolate; *end-view* nearly ovate.

The series of Tertiary and Cretaceous Entomostraca, from France and Belgium, with which M. Bosquet has kindly favoured me, comprises a specimen of *C. perforata*, Roemer; and hence I am enabled to point out that there are no essential differences between the forms enumerated above in the list of the Synonyms of this species. The greater relative size and ovateness of the left valve,—the apparent presence of setæ, arising from optical appearances under the microscope, in some specimens,—slight variations in the convexity of the surface and the coarseness of the punctations, and the occasional presence of marginal spines—constitute the differences among specimens from different localities.

Cytheridea incrassata, Bosquet ('Entom. Tert.,' p. 44, t. 3, f. 11), is evidently a closely allied form; and so also are *Bairdia sub-trigona*, Bornemann ('Zeitsch. Deut. geol. Ges.,' vii, p. 357, t. 20, f. 4), and *Cytheridea punctatella*, Bornemann (ibid., p. 360, t. 21, f. 2).

Cythere (*Cytheridea*) *perforata* occurs in the Upper Eocene Clays at Barton, on the Hampshire coast, and in the sands of the same age at Colwell Bay, Isle of Wight: (and two varieties in the London Clay, near London). M. Bosquet found it (*B. perforata*) in the "Sables moyens," Tancrou (Seine-et-Marne), and the "Calcaire grossier," Damery (Marne) and Montmirail (Aisne). Roemer derived his specimens from the Paris Tertiaries. I have it also from the "Calcaire grossier supérieur."

As a Cretaceous form, it occurs in the Maestricht Chalk at Kunraede (*Bosquet*), in the Chalk of Balsberg, in Sweden, and of Kent (rare), in the Chalk-marl of Charing and Dover, in the Gault of Kent, and the Greensand (so-called) of Blackdown.

Var. *INSIGNIS*, *nov.* Plate VI, figs. 3 *a*—3 *c*.

INCH.

Length, $\frac{1}{24}$

Lower Eocene: London.

Right carapace-valve sub-triangular, depressed towards each end; anterior border with a slightly raised marginal rim: *surface* thickly punctate, pittings coarser towards the middle, where they follow short sunken transverse lines.

Dorsal aspect of carapace sub-fusiform.

From the London Clay of the Copenhagen Fields, near London; obtained with others by Mr. J. Purdue during the cutting of the Great Northern Railway.

Var. *GLABRA*, *nov.* Plate V, figs. 24 *a*, 24 *b*.

INCH.

Length, $\frac{1}{27}$

Lower Eocene; London.

Right carapace-valve sub-triangular, depressed anteriorly; similar in outline to the right valve of *C. perforata*, but rather more angular before and behind; the two extremities bordered by a slightly raised, smooth, marginal rim: *surface* smooth, not punctate.

Dorsal aspect of carapace acute-lanceolate.

From the London Clay of the Copenhagen Fields, London.

Sub-genus—*CYTHERIDEIS*, *nov.* *Cythere*, Auctorum.

Animal a *Cythere*? *Carapace* more or less triangular; surface smooth, pitted, or tuberculate: *hinge-margin* simple, except that, the central portion of the dorsal margin of the left valve being somewhat incurved under that of the right valve (when they are closed), the anterior and posterior angles of the dorsal margin of the left valve remain somewhat projecting, and present internal shallow furrows for the reception of the corresponding angles of the opposite valve: ventral margin partially incurved.

This is a more distinct form of the hingement that generally obtains in *Cypris*.

No. 1. CYTHERIDEIS TRIGONALIS, *Jones*. Plate II, figs. 2 *a*—2 *h*.CYTHERE TRIGONALIS, *Jones*. Annals and Mag. Nat. Hist., 2d ser., vi, p. 28, t. 3, fig. 5.

INCH.

Length, $\frac{1}{11}$

Recent: Pegwell Bay, Kent.

Pleistocene: Essex.

Carapace obtusely triangular, convex, finely punctated with angular pittings (fig. 2 *h*); extremities obliquely rounded; anterior portion much broader and somewhat more depressed than the posterior; ventral border nearly straight, dorsal angular; hinge-margin oblique and faintly developed, anterior hinge accompanied by slight marginal teeth. *Lucid spots* (fig. 2 *g*) of the System B, page 5.

Dorsal aspect acute-oval.

The outline-form of this species is not uncommon in the genera *Cypris* and *Cythere*, and especially in the sub-genus *Cytheridea*.

A unique specimen of this interesting form was obtained from the Pleistocene or Post-pliocene formation at Clacton, and is identical with a recent form from the sand of Pegwell Bay¹ (for which I am indebted to Mr. Pickering), except that the latter has denticles, or short blunt spines, on the anterior and posterior margins, as is usual with the genus *Cythere*.

A smooth form, Var. *LÆVIS*, which occurs plentifully in the pleistocene sand at Grays, differs from the Clacton specimen merely in the want of pittings.

No. 2. CYTHERIDEIS TUBERCULATA, *spec. nov.* Plate II, figs. 3 *a*—3 *f*.

INCH.

Length, $\frac{1}{27}$

Pleistocene: Red Crag, Essex.

Pliocene: Crag, Suffolk.

Carapace convex, sub-triangular, depressed anteriorly; extremities rounded; posterior end contracted; ventral border slightly incurved; dorsal border strongly angular; hinge-line occupying the posterior two thirds of the dorsal edge: *surface* of valves ornamented with tubercles arranged loosely in about eight longitudinal rows, with about twelve in the longest row.

Dorsal aspect acute-oval; *end-view* sub-ovate.

Cythere (*Cytherideis*) *tuberculata* occurs in the Crag of Suffolk, and in the Red Crag at Walton, Essex; but appears to be rare.

¹ Probably this, like the specimens of *Candona reptans* and *C. Candida*, mentioned at p. 17, was not of marine origin, but derived from the Stour River, which empties itself into the Bay.

No. 3. CYTHERIDEIS UNISULCATA, *Jones*. Plate IV, fig. 10.CYTHERIDEIS UNISULCATA, *Jones*. Memoirs Geol. Survey, 1856, p. 157, t. 7, fig. 23.

INCH.

Length, $\frac{1}{40}$

Upper Eocene: Isle of Wight.

Valve triangular, broadest anteriorly, convex, impressed across the middle by a transverse furrow.

The only specimen that I have met with is very small and not well preserved: its characters, however, are sufficiently distinct for notice.

It occurs with *Candona Forbesii* in the green shales of the Osborne series, at Cliff End, Colwell Bay, Isle of Wight.

No. 4. CYTHERIDEIS UNICORNIS, *Jones*.CYTHERIDEIS UNICORNIS, *Jones*. Memoirs Geol. Survey, 1856, p. 158 t. 7, fig. 24—26.

INCH.

Length, $\frac{1}{24}$

Upper Eocene: Isle of Wight.

Valves thick, sub-triangular in the young state, almost oblong when adult, broadest and most depressed anteriorly. Young individuals are impressed on the middle of the dorsal portion of each valve with two more or less distinct transverse furrows, the posterior of which is the largest and most constant. The anterior furrow is shorter and more oblique than the other, and often runs into it, forming a Y-like impression. The furrows are associated with several irregular tubercles, of slight elevation, one of which, placed behind the chief furrow, is persistent, and increases in size, whilst the others disappear as the animal grows older and the carapace enlarges. The furrows also gradually disappear with the advanced growth of the animal, until a single, slightly recurved spine, or pointed tubercle, remains on the postero-dorsal third of each valve. The surface of the valves is faintly and irregularly punctate.

Dorsal aspect narrow-acute-oval, modified by the lateral spines.

This interesting species has much of the general character of the oblong and tubercled *Cyprideis* (page 21); but it wants the knurled hinge-teeth of the latter sub-genus.

Cythere (*Cytherideis*) *unicornis* is very plentiful in a crushed state between the laminæ of a dark-grey marl of the Hempstead series, at Hempstead Cliff, Isle of Wight. The specimens were submitted to me, and have been described for the Geological Survey, whilst this Monograph was in progress, and since the plates were finished.

No. 5. CYTHERIDEIS (?), *spec.* Plate VI, fig. 15.

INCH.

Length, $\frac{1}{17}$

Lower Eocene : Kent.

Casts of oblongo-triangular convex valves of a species probably referable to this sub-genus were found by the late Rev. H. M. De la Condamine in a black clay, belonging to the Woolwich Series, at New Cross. They somewhat resemble the more obtuse forms of *Cytherideis trigonalis* ; but I hesitate to determine their specific relations.

No. 6. CYTHERIDEIS TAMARINDUS, *spec. nov.* Plate III, figs. 4 a, 4 b.

INCH.

Length, $\frac{1}{27}$

Pliocene : Suffolk.

Carapace obliquely sub-oblong, or sub-rhomboidal, somewhat resembling a tamarind-stone in shape ; extremities obliquely rounded ; anterior extremity sloping towards the dorsal, and posterior border sloping towards the ventral margin ; dorsal border straight, ventral somewhat sinuous : *valves* depressed, most convex backwards, thickened at the extremities, and bordered posteriorly by a narrow flattened rim ; surface ornamented with a few faint concentric ridges towards the anterior and ventral margins, and marked all over with a faint reticulate punctation [not shown in the drawing, fig. 4].

Dorsal aspect elongate-compressed-ovate ; *end-view* narrow-subovate.

Cythere (*Cytherideis*) *Tamarindus* is rare in the Crag of Suffolk.

No. 7. CYTHERIDEIS COLWELLENSIS, *spec. nov.* Plate IV, figs. 13 a,—13 c,
20 a—20 c.

INCH.

Length, $\frac{1}{25}$

Upper Eocene : Isle of Wight.

Carapace oblong, most convex posteriorly ; extremities rounded, the anterior end more or less obliquely ; dorsal border gently arched ; ventral nearly straight : *surface* smooth or faintly punctate.

Dorsal aspect narrow-acute-ovate ; *end-view* blunt-oval.

Cythere (*Cytherideis*) *Colwellensis* occurs at Colwell Bay, Isle of Wight, in the Nucula-bed (*Nucula deltoidea*) and other deposits ; but is not abundant.

No. 8. CYTHERIDEIS BARTONENSIS, *spec. nov.* Plate V, figs. 2 *a*, 2 *b*, 3 *a*, 3 *b*.

INCH.

Length, $\frac{1}{3\frac{1}{4}}$

Upper Eocene: Barton, Hants.

Carapace oblong; rounded in front; rounded obliquely behind; dorsal and ventral borders straight, the surface of the valve suddenly sloping inwards at the latter border; most convex rather behind the centre; surface smooth.

Dorsal aspect elongate-sub-oval; *end-view* sub-ovate.

This species appears to be related to *Bairdia* [?] *lavissima*, Bornemann ('Zeitsch. Deut. geol. Ges.,' vii, p. 358, t. 20, fig. 6), and *Cytheridea* [?] *papillosa*, Bosquet ('Entom. Tert.,' p. 42, t. 2, fig. 5).

I have found *Cythere* (*Cytherideis*) *Bartonensis* only in the Barton Clay, where it is apparently rare.

No. 9. CYTHERIDEIS FLAVIDA, *Müller, sp.* Plate IV, figs. 4 *a*—4 *c*.

CYTHERE FLAVIDA, *Müller*. Entomostraca, p. 66, t. 7, figs. 5, 6.

— — *Latreille*. Hist. Nat. Crust., iv, p. 253.

— — *Desmarest*. Consid. Crust., p. 388.

— — *Bosc.* Man. d'Hist. Nat. Crust., ii, p. 284.

— — *Baird*. Mag. Zool. Bot., ii, p. 184; Trans. Berw. Nat. Club, ii, p. 153; Brit. Entom., p. 168, t. 21, fig. 12.

MONOCULUS FLAVIDUS, *Gmelin*. Linn. Syst. Nat., p. 3001, No. 33.

— — *Fabricius*. Ent. Syst., ii, p. 494.

— — *Manuel*. Enc. Méth., vii, p. 725, t. 266, figs. 10, 11.

— — *Rees*. Cyclopæd., art. Monoculus.

INCH.

Length, $\frac{1}{2\frac{1}{5}}$

Recent: Britain; Europe.

Pliocene: Suffolk.

Upper Eocene: Isle of Wight.

Carapace elongate, cylindrical, tapering in front, arched on the back, straight or gently incurved on the ventral border, rounded at the extremities, most convex and obtuse posteriorly; surface smooth or slightly papillate. [The specimen figured illustrates the narrower and more curved variety of this form.]

Dorsal aspect elongate-narrow-ovate; *end-view* sub-orbicular.

This species is near to *Cythere arcuata*, Münster, and some of its varieties (see Bosquet, 'Crust. foss. Limbourg,' p. 59); but its extreme convexity and the obtuseness of the hinder end sufficiently distinguish it. Among its many other allies, it also approaches *Bairdia* [?] *mytiloides*, Bosquet, in outline; but wants its ornamentation.

Cythere (*Cytherideis*) *flavida*¹ abounds in the recent state along the coasts of Britain,² and in the Baltic. It is abundant in the Crag of Suffolk; and occurs also, but much less frequently, in the Upper Eocene Lands of Colwell Bay, Isle of Wight.

No. 10. CYTHERIDEIS REN, *spec. nov.* Plate IV, figs. 5 *a*, 5 *b*.

INCH.

Length, $\frac{1}{27}$

Pliocene: Suffolk.

Carapace quadrangularly reniform; extremities obliquely rounded, curving up to meet the short straight hinge-line occupying the central third of the dorsal border; anterior extremity smaller and more oblique than the posterior; ventral border sinuous, strongly incurved at the middle: *surface* rather depressed, smooth, with the exception of some obscure papillæ and pittings, partially distributed. *Lucid spots* eight, long-oval, arranged in two oblique transverse rows in the middle of the valve and rather ventrally.

Dorsal aspect narrow-oblong, slightly tapering, and with rounded ends; *end-view* sub-oval.

Cythere (*Cytherideis*) *Ren* is perhaps related to *C. pilosella*, Reuss.

This species is from the Crag of Suffolk, and is rare.

Sub-genus—BAIRDIA,³ *M'Coy, gen.*

Animal a *Cythere*. *Carapace* varying from a broadly triangular to a narrow elongate sub-triangular form, with extremities more or less acute; surface smooth and setiferous or finely punctate; no central tubercle; lucid spots well marked: *margins* thin and trenchant; when closed, the edges of the right valve lie within those of the left: interior of the marginal borders (except on the dorsal edge) cased with a narrow lamelliform plate (as in *Cypris*): except that a slight fold or notch is frequently apparent at the angles of the hinge-line, the dorsal edge of the right valve is quite simple, and, in the closed carapace, underlies the dorsal edge of the left valve, which is larger and overlapping: ventral margin incurved.

Among the species which I assigned to *Bairdia*, in 1849, some appear to me to be sufficiently distinct, especially in their hinging, to be divided off and arranged

¹ Zenker has well remarked that colour is a bad characteristic for specific determinations of these Entomostraca; the colour often varying with different food and other circumstances. With regard to the species referred by Zenker to *C. flavida*, Müller, I have already remarked (see p. 23).

² I have procured it from Southend, Margate, Poole Bay, Tenby, and Scarborough; and Dr. Baird quotes it from Torquay and Berwickshire.

³ See 'Monog. Entom. Cret.,' 1849, p. 22.

in a new sub-genus, *Cytherideis* (see p. 46); for instance, *C. angusta*, 'Monog. Cret. Entom.' pl. 6, fig. 18.

Amongst the "Bairdiæ" of Bosquet, Reuss, and Bornemann, there are, I believe, included several species both of *Cytheridea* and *Cytherideis*.

No. 1. BAIRDIA SUBDELTOIDEA, *Münster, sp.* Plate IV, figs. 2 *a*, 2 *b*, 3; Pl. VI, figs. 1 *a*, 1 *b*, 2.

CYHERE SUBDELTOIDEA, *Münster.* Jahrb. f. Min., &c., 1830, p. 64; Neues Jahrb. f. Min., &c., 1835, p. 446.

CYOTHERINA SUBDELTOIDEA, *F. A. Roemer.* *Ibid.*, 1838, p. 517, t. 6, fig. 16.

— — *Hauer.* *Ibid.*, 1839, p. 429.

— — *F. A. Roemer.* Verstein. Nordd. Kreid., p. 105, t. 16, fig. 22.

— — *Geinitz.* Charact. Sachs.-Böhm. Kreid., 3 Abth., p. 64.

— — *Ib.* Grund. Verstein., p. 244, t. 8, fig. 21.

— — *Reuss.* Verstein. Böhm. Kreid., 1 Abth., p. 16, t. 5, fig. 38; and 2 Abth., p. 104.

— — *Ib.* Haidinger's Abhandl., iii, p. 49, t. 8, fig. 1.

— — *Ib.* *Ibid.*, iv, p. 47.

— — *Ib.* Apud Geinitz, Quadersandst. oder Kreid. Deutsch., p. 93, No. 10.

— — *Eichwald.* Lethæa Rossica, t. 11, fig. 23.

— — *Naumann.* Lehrb. Geogn., 2. Hälfte, t. 60, fig. 24.

— TRIGONA, *Bosquet.* Mém. Soc. Roy. Liège, iv, p. 358, t. 1, fig. 3.

BAIRDIA SUBDELTOIDEA, *Ib.* Mém. Couron. Acad. Belg., xxiv, p. 29, t. 1, fig. 13.

CYHERE (BAIRDIA) SUBDELTOIDEA, *Jones.* Monog. Entom. Cret., p. 23, t. 5, fig. 15.

— — — *Reuss.* Denkschrift. d. Akad. Wiss. Wien., vii, pp. 41, 139.

INCH.

Length, $\frac{1}{41}$ $\frac{1}{26}$ $\frac{1}{15}$

Recent: Britain; West Indies; Mauritius; Manilla; Australia.

Tertiary: Britain; Europe; Virginia.

Cretaceous: Britain; Europe.

Carapace triangular, gibbous, acute at the extremities, smooth or setiferous and sometimes finely punctate; right valve smaller and more angular than the left. [For a fuller description of the valves, see 'Monog. Entom. Cret. Form.,' p. 23.]

Cythere (Bairdia) subdeltoidea is a common form in the Tertiary deposits throughout Europe; it is plentiful in the Tropical Seas,¹ and occurs also on the British coasts.²

¹ The *B. subdeltoidea* of Australia is punctate, and has the rosette-like lucid spots of the Chalk form of this species; that of Turk's Island, Bahamas, more resembles the Crag form both in its globosity and in the less compactness of the spots.

² The *B. subdeltoidea* of Arran, here referred to, is evidently a variety, being narrow and presenting a difference in the arrangement of its lucid spots.

It is abundant in the Chalk of England and Europe, and occurs also in the Upper Greensand, but not in the Gault. I have it also from the Miocene of Virginia, U.S. It has near allies in the Magnesian and Carboniferous Limestones of Britain, and in the Carboniferous Shales and "Bituminous Limestone" of Southern Australia.

With this extensive distribution of the species in question, there is, of course, much variation in comparatively unessential characters, especially in the superficial papillæ (bases of setæ) and punctation, and the setation of the surface and extremities; the relative size of the carapace and its angularity also vary considerably; and I believe that the lucid spots will be found on careful examination of transparent valves to present some differences of form (a character probably of more importance than any afforded by spines or pittings).

In the specimens from the Crag of Sutton and elsewhere in Suffolk, the carapace is larger, has a somewhat more rounded outline (fig. 2 *a*), and is more globose than the Chalk form; and the lucid spots, though arranged in a similar rosette-like pattern (fig. 2 *b*), are further apart, and, not being compressed one against the other, have more oval outlines. The surface of the valves, from the presence of papillæ, appears to have been setous. The very small individual (fig. 3) occurred in the Red Crag of Walton, Essex; and one specimen of a narrow variety was met with in the Suffolk Crag.

The London Clay of Copenhagen Fields, near London, has yielded some handsome specimens (pl. 6. figs. 1, 2), covered with a close punctation, and finely denticulated at the extremities,—conditions not unfrequently met with in recent specimens.

NO. 2. *BAIRDIA CONTRACTA*, *spec. nov.* Plate V, figs. 1 *a*—1 *c*.

INCH.

Length, $\frac{1}{2\frac{1}{2}}$

Middle Eocene: Barton, Hampshire.

Carapace elongate-triangular, sub-cylindrical; most convex at the middle of the ventral portion; rounded in front; obliquely acute behind; sinuate on the ventral, and arched, with an obscure three-sided outline, on the dorsal border; hinge-line occupying the middle third of the dorsal edge: *surface* smooth.

Dorsal aspect narrow-acute-oval; *end-view* sub-ovate.

This species approaches *Bairdia cylindracea*, Bornemann ('Zeitsch. Deutsch. geol. Ges.,' vii, p. 359, t. 20, fig. 5), from the Septarian Clay of Hermsdorf, near Berlin.

Cythere (Bairdia) contracta was found by Mr. F. Edwards in the Barton Clay, Hampshire: it is rare.

Sub-genus—CYTHERELLA,¹ Jones.

Animal unknown. *Carapace* oblong, compressed; smooth or pitted; no terminal denticulations: contact-margins of the right (larger) valve grooved or rabbeted on its inner edge for the reception of a flange presented by the contact-margin of the left (smaller) valve; both groove and flange stronger at the posterior, than at the anterior portion of the valves.

The *lucid spots* (see p. 56) resemble those in *Cypridina* rather than those of *Cythere* and its sub-genera.

No. 1. CYTHERELLA COMPRESSA, Münster, *sp.* Plate V, figs. 21, 23.

CYTHERE COMPRESSA, Münster. Jahrb. f. Min., &c., 1830, p. 64; Neues Jahrb., &c., 1835, p. 445.

CYTHERINA COMPRESSA, Roemer. Neues Jahrb., &c., 1838, p. 517, t. 6, fig. 14.

— ACICULATA, Ib. Ibid., t. 6, fig. 21. [According to M. Bosquet.]

— COMPRESSA, Reuss. Haidinger's Abhandl., iii, p. 54, t. 8, fig. 15.

— — Bosquet. Mém. Couron. Acad. Belg., xxiv, p. 11, t. 1, fig. 1.

? CYTHERELLA FABACEA, Bornemann. Zeitsch. Deutsch. geol. Ges., vii, p. 355, t. 20, fig. 2.

INCH.

Length, $\frac{1}{30}$ to $\frac{1}{25}$

Recent: Australia (?); Norway.

Tertiary: England; Europe.

Carapace ovate-oblong or oblong; rounded at the ends; more or less arched on the dorsal, nearly straight on the ventral border: *valves* smooth, sometimes faintly punctate, depressed, most convex posteriorly and rather ventrally, broadest anteriorly, with the anterior border sometimes raised into a slight marginal rim (fig. 23).

Dorsal profile narrow-acute-ovate or subcuneiform; *end-view* sub-ovate.

The blue clay of Bracklesham and the London Clay of the Copenhagen Fields, London, both yield this species; which has also been found at Castell' Arqauto and at Osnabrück, and in the Belgian and the Austro-Hungarian Tertiaries.

Cytherella compressa seems to replace in the Tertiary deposits the *C. ovata* of the Chalk,—to which it is nearly allied.

It occurs also as a finely punctate form on the Coast of Norway (from Messrs. M'Andrew and Barrett's dredgings); and I have a nearly related form from Australia.

¹ For synonyms see 'Monog. Entom. Cret.,' 1849, p. 28; where further details are also given of the form and character of the valves. Since the publication of the Monograph alluded to, *Cytherella*, like the other sub-genera there established has been referred to as a genus,—and perhaps on better grounds than in the other instances.

Var. 1. Plate V, fig. 18.

? CYTHERELLA BEYRICHI, *Bornemann*. [? *Cytherina Beyrichi*, Reuss.] Zeitsch. Deutsch. geol. Ges., vii, p. 354, t. 20, fig. 1.

INCH.

Length, $\frac{1}{36}$

Lower Eocene: London.

Carapace sub-quadrangular; extremities rounded and more or less denticulate: *valves* depressed anteriorly, convex behind; marked with a strong uniform punctation.

Dorsal profile narrow-acute-ovate; *end-view* sub-oval.

From the London Clay of the Copenhagen Fields, near London.

Var. 2. Plate V, fig. 19.

? CYTHERELLA INTERMEDIA, *Bornemann*. Zeitsch. Deutsch. geol. Ges., vii, p. 355, t. 20, fig. 3.

INCH.

Length, $\frac{1}{28}$

Lower Eocene: London.

In this variety the valves are narrower and less square than in Var. 1 (fig. 18), and the punctation is obscure and partial; the convexity of the valves is more uniform, the anterior portion not being so much depressed as either in Var. 1, or in the typical form.

From the London Clay of Copenhagen Fields.

No. 2. CYTHERELLA LONDINENSIS, *spec. nov.* Plate V, figs. 20, 22.

INCH.

Length, $\frac{1}{27}$

Lower Eocene: London.

Carapace nearly oblong, rounded at the ends, dorsal border slightly curved, sloping more rapidly towards the posterior than towards the anterior margin; ventral margin slightly incurved at the middle; left valve much narrower than the right; valves smooth, depressed, marked by an irregular triangular impression, sub-central and towards the dorsal edge [not well shown in the figures], and bearing slightly raised narrow marginal rims, variable in development; convexity nearly uniform, slightly stronger on the anterior than on the posterior moiety of the valves.

Dorsal profile narrow sub-oblong, slightly produced at the ends; *end-view* sub-oval.

Cytherella Londinensis is from the London Clay of the Copenhagen Fields, near

London, and is well distinguished from *C. compressa* by its marginal rims, central impression, and very different dorsal profile, arising from the more uniform convexity of the valves.

No. 3. *CYTHERELLA MUNSTERI*, Roemer, *sp.* Plate V, figs. 12 *a*, 12 *b*, 13.

CYTHERINA MUNSTERI, Roemer. Neues Jahrb. f. Min., &c., 1838, p. 516, t. 6, fig. 13.

— *PARALLELA*, Reuss. Verstein. Böhm. Kreid., 1 Abth., p. 16, t. 5, fig. 33; and Haidinger's Abhandl., iv, p. 48, t. 6, fig. 1.

CYTHERE TRUNCATA, Bosquet. Mém. Soc. Roy. Liège, iv, p. 357, t. 1, fig. 2.

— (*CYTHERELLA*) *TRUNCATA*, Jones. Monog. Entom. Cret., p. 30, t. 7, fig. 35.

CYTHERELLA MUNSTERI, Bosquet. Mém. Couron. Acad. Belg., xxiv, p. 13, t. 1, fig. 2.

— — *Ib.* Mém. Commiss. Carte géol. Neerl., ii, p. 58, t. 8, fig. 2.

INCH.

Length, $\frac{1}{3}$

Recent: Australia; Norway.

Tertiary: England; Europe; North America.

Cretaceous: England; Europe.

Carapace oblong; extremities rounded; dorsal margin somewhat curved: *valves* depressed anteriorly, convex posteriorly, smooth, punctate with pits in linear arrangement, punctuation sometimes strong (fig. 12), sometimes obsolete (fig. 13). [See 'Monog. Entom. Cret.,' p. 30, for fuller details.]

The *lucid spots* are numerous, small, and closely packed together; they occupy a sub-triangular space near the centre of the valve and rather ventrally, and are arranged in two parallel, slightly curved rows, the largest spots at the ventral end and the smaller ones gradually tapering upwards, so that the spots form a short broad feather-like patch.

Dorsal aspect elongate wedge-shaped; *end-view* sub-oval.

Cytherella Munsteri is very closely related to *C. compressa* and *C. ovata*.

Specimens of *C. Munsteri* occur at Colwell, Barton, Bracklesham, and in the London Clay of Copenhagen Fields and of Wimbledon Common, near London.

This species is also found in the Tertiary and the Cretaceous beds of Belgium and the Netherlands; the Cretaceous beds of Bohemia, Galicia, and Sweden; and in the White Chalk, Chalk-marl, and Gault of England. I have also found it in a Tertiary sand from Alabama. Coarsely punctate valves of *C. Munsteri* occur in the dredged sand from the Norway Coast, with which Messrs. M'Andrew and Barrett have favoured me; and I have a delicate smooth variety from Australia (where also a *Cytherella* of the *C. Williamsoniana* type occurs recent).

APPENDIX.

TABLE I.—*Showing the Distribution of CYPRIS, CANDONA, and CYPRIDEIS in the Tertiary and Post-tertiary deposits of England.*

| SPECIES. | Recent. | Berkshire. | Cambridgeshire. | Lincolnshire. | Forfarshire. | Edwardstone. | Copford. | Grays. | Clacton. | Chisle. | Wear Farm. | Cliff End. | Hempstead Cliff. | Hordwell. | Woolwich. |
|---|---------|----------------|-----------------|---------------|--------------|--------------|--------------|--------|----------|---------|------------|------------|------------------|-----------|-----------|
| CYPRIS (genus). | | | | | | | | | | | | | | | |
| 1. <i>setigera</i> , Jones | ? | * | * | | | | | | | | | | | | |
| 2. <i>Browniana</i> , Jones | .. | .. | .. | .. | .. | .. | .. | .. | * | | | | | | |
| — <i>var. tumida</i> , Jones | .. | .. | .. | .. | .. | .. | .. | * | | | | | | | |
| 3. <i>Ovum</i> , Jurine | * | * | * | | | | | * | * | | | | | | |
| 4. <i>gibba</i> , Ramdohr | * | * | * | | | | | * | * | | * | | | | |
| CANDONA (genus). | | | | | | | | | | | | | | | |
| 1. <i>reptans</i> , Baird | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 2. <i>Forbesii</i> , Jones | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 3. <i>Richardsoni</i> , Jones | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 4. <i>candida</i> , Müller | * | * | * | ? | * | * | * | * | * | * | * | * | * | * | * |
| 5. <i>subæqualis</i> , Jones | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| CYPRIDEIS (sub-genus?). | | | | | | | | | | | | | | | |
| 1. <i>torosa</i> , Jones | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 10 | Recent. | Post-tertiary. | | | | | Pleistocene. | | | | | Eocene. | | | |

TABLE II (continued).

| SPECIES. | Eocene. | | | | | | | | | | | | | | | Tertiary. | | Cretaceous. | | |
|-------------------------|---------|------------------------------------|------------------------------|----------------------|----------------------------|---------|------------------|------------|--------------|---------------|-------------|--------------|-----------|---------------|--------------|--------------------------------|--|-------------|------------------------------|---------------|
| | Recent. | Pleistocene. Grays and Clacton. | Pleistocene. Bridlington. | Pliocene. Walton. | Pliocene. Suffolk Crag. | Eocene. | | | | | | | | | | England. | Europe. | | | |
| | | | | | | Upper. | Middle. | | | | | Lower. | | | | | | | | |
| | | | | | | | Hempstead Cliff. | Cliff End. | Colwell Bay. | Barton Cliff. | High Cliff. | Bracklesham. | Alum Bay. | East Woodhay. | London Clay. | | | | Woolwich and Reading Series. | Thanet Sands. |
| | | | | | | | | | | | | | | | | | | | | |
| CYTHERIDEA— | | | | | | | | | | | | | | | | | | | | |
| 1. Mulleri, Münst. | * | | | | | * | * | 3 | 15 | | | | | * | | { U. E., M. E., & L. E. | { Plioc., Mioc., U. E., & M. E. | | | |
| var. torosa, Jones | | | | | | * | | | | | | | | * | | { U. E. & L. E. | | | | |
| 2. debilis, Jones | * | | | | | | | 35 | | | | | | | | M. E. | | | | |
| 3. pinguis, Jones | | | | | 27 | | | | | | | | | | | Plioc. | | | | |
| 4. Sorbyana, Jones | | | * | | | | | | | | | | | | | Pleist. | | | | |
| 5. perforata, Roem. | | | | | | | | 3 | 6 | | | | | | | M. E. | M. E. | * | | |
| var. insignis, Jones | | | | | | | | | | | | | 3 | | | L. E. | | | | |
| var. glabra, Jones | | | | | | | | | | | | | 1 | | | L. E. | | | | |
| CYTHERIDEIS— | | | | | | | | | | | | | | | | | | | | |
| 1. trigonalis, Jones | * | * | | | | | | | | | | | | | | Pleist. | | | | |
| 2. tuberculata, Jones | | | | 1 | 3 | | | | | | | | | | | Plioc. | | | | |
| 3. unisulcata, Jones | | | | | | * | | | | | | | | | | U. E. | | | | |
| 4. unicornis, Jones | | | | | | | * | | | | | | | | | U. E. | | | | |
| 5. spec. indetermin. | | | | | | | | | | | | | * | | | L. E. | | | | |
| 6. Tamarindus, Jones | | | | | 3 | | | | | | | | | | | Plioc. | | | | |
| 7. Colwellensis, Jones | | | | | | | | 5 | | | | | | | | M. E. | | | | |
| 8. Bartonensis, Jones | | | | | | | | | 2 | | | | | | | M. E. | | | | |
| 9. flavida, Müller | * | | | | 36 | | | 4 | | | | | | | | { Plioc. & M. E. | | | | |
| 10. Ren, Jones | | | | | 1 | | | | | | | | | | | Plioc. | | | | |
| BAIRDIA— | | | | | | | | | | | | | | | | | | | | |
| 1. subdeltoidea, Münst. | * | | | 1 | 22 | | | | 1 | | | | 2 | | | { Plioc., M. E., & L. E. | { Plioc., Mioc., U. E., & M. E. | * | | |
| 2. contracta, Jones | | | | | | | | | 3 | | | | | | | M. E. | | | | |
| CYTHERELLA— | | | | | | | | | | | | | | | | | | | | |
| 1. compressa, Münst. | * | | | | | | | | | 2 | | 4 | | | | { M. E. & L. E. | { Plioc., Mioc., & U. E. | | | |
| var. 1 | | | | | | | | | | | | 1 | | | | L. E. | | | | |
| var. 2 | | | | | | | | | | | | 1 | | | | L. E. | | | | |
| 2. Londinensis, Jones | | | | | | | | | | | | 1 | | | | L. E. | | | | |
| 3. Munsteri, Roem. | * | | | | | | | 1 | 3 | 2 | | 3 | | | | { M. E. & L. E. | M. E. | * | | |

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TABLE III.—*Showing the Distribution of species of the Tertiary and Post-tertiary Entomostraca of England.*

| | | | LOCALITIES. | CYPRIS. | CANDONA. | CYPRIDEIS. | CYTHERE proper. | CYTHEREIS. | CYTHERIDEA. | CYTHERIDEIS. | BAIRDIA. | CYTHERELLA. | Number of Species enumerated from the several localities. | |
|---------------------|----|---------|--------------------------------------|---------------------------|----------|------------|-----------------|------------|-------------|--------------|----------|-------------|---|---|
| POST-TERTIARY. | | | Newbury | 2 | 2 | .. | .. | .. | .. | .. | .. | .. | 4 | |
| | | | Cambridgeshire | 3 | 2 | .. | .. | .. | .. | .. | .. | .. | 5 | |
| | | | Lincolnshire | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | |
| | | | Loch Bakie | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | |
| | | | Edwardstone | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | |
| PLEISTOCENE. | | | Copford | .. | 2 | .. | .. | .. | .. | .. | .. | .. | 2 | |
| | | | Grays | 2 | 2 | 1 | .. | .. | .. | .. | .. | .. | 5 | |
| | | | Clacton | 2 | 2 | 1 | .. | .. | .. | .. | .. | .. | 5 | |
| | | | Chislet | .. | .. | 1 | .. | .. | .. | .. | .. | .. | 1 | |
| | | | Wear Farm | 1 | .. | 1 | .. | .. | .. | .. | .. | .. | 2 | |
| PLIOCENE. | | | Bridlington | .. | .. | .. | 1 | .. | 1 | .. | .. | .. | 2 | |
| | | | Walton | .. | .. | .. | 1 | .. | .. | 1 | 1 | .. | 3 | |
| | | | Sutton, &c. | .. | .. | .. | 10 | 2 | 1 | 4 | 1 | .. | 18 | |
| | | | Upper. | Hempstead Cliff | .. | 1 | .. | .. | .. | 1 | 1 | .. | .. | 3 |
| | | | | Hordwell Cliff | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 |
| Cliff End | .. | 1 | | .. | .. | .. | 1 | 1 | .. | .. | 3 | | | |
| EOCENE. | | Middle. | Colwell Bay | .. | .. | .. | 3 | 1 | 3 | 2 | .. | 1 | 10 | |
| | | | Barton Cliff | .. | .. | .. | 4 | 1 | 2 | 1 | 2 | 1 | 11 | |
| | | | High Cliff | .. | .. | .. | 2 | .. | .. | .. | .. | .. | 2 | |
| | | | Bracklesham Bay | .. | .. | .. | 4 | 2 | .. | .. | .. | 2 | 8 | |
| | | | Alum Bay | .. | .. | .. | 2 | .. | .. | .. | .. | .. | 2 | |
| | | Lower. | East Woodhay | .. | .. | .. | 1 | .. | .. | .. | .. | .. | 1 | |
| | | | London (Copenhagen Fields) | .. | .. | .. | 2 | 1 | 1 | .. | 1 | 2 | 7 | |
| | | | Woolwich | .. | 1 | .. | 1 | .. | 1 | 1 | .. | .. | 4 | |
| | | | Clay Hill, Shaw | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 1 | |
| | | | Pegwell Bay | .. | .. | .. | .. | 1 | .. | .. | .. | .. | 1 | |

| | | | CYPRIS. | CANDONA. | CYPRIDEIS. | CYTHERE proper. | CYTHEREIS. | CYTHERIDEA. | CYTHERIDEIS. | BAIRDIA. | CYTHERELLA. | Total. | |
|---|--|--|-------------------------|----------|------------|-----------------|------------|-------------|--------------|----------|-------------|--------|----|
| Number of Species in the | | | Post-tertiary | 3 | 3 | .. | .. | .. | .. | .. | .. | 6 | |
| | | | Pleistocene | 2 | 2 | 1 | 1 | .. | 1 | .. | .. | 7 | |
| | | | Pliocene | .. | .. | .. | 11 | 2 | 1 | 5 | 1 | .. | 20 |
| | | | Upper Eocene | .. | 1 | .. | .. | .. | 1 | 2 | .. | .. | 4 |
| | | | Middle Eocene | .. | .. | .. | 9 | 2 | 3 | 3 | 2 | 2 | 21 |
| | | | Lower Eocene | .. | 1 | .. | 3 | 2 | 2 | 1 | 1 | 3 | 13 |
| Number of Species described in this Monograph | | | 4 | 5 | 1 | 22 | 6 | 5 | 10 | 2 | 3 | 58 | |

TABLE IV.—*Showing the Distribution of the European Tertiary Entomostraca that have been recognised as occurring in England.*

| SPECIES. | Upper Tertiary. | | | Middle Tertiary. | | | | | | | Middle Eocene, France. |
|-------------------------------------|-----------------|------------------|------------|------------------|------|-----------|-----------|----------------------------|-------------------|----------------|------------------------|
| | Palermo. | Castell' Arguto. | Perpignan. | Antwerp Crag. | Dax. | Bordeaux. | Touraine. | Austro-Hungarian Tertiary. | Mayence Tertiary. | Upper Silesia. | |
| <i>Cythere punctata</i> , Münt. | . | . | . | . | . | . | . | . | . | . | * |
| — <i>striato-punctata</i> , Roem. | * | * | * | . | . | . | . | . | . | . | * |
| — <i>Kostelensis</i> , Reuss. | . | . | . | . | . | . | . | . | . | . | * |
| — <i>costellata</i> , Roem. | . | . | . | . | . | . | . | . | . | . | * |
| — <i>plicata</i> , Münt. | . | . | . | . | . | . | . | . | . | . | * |
| — <i>angulato-pora</i> , Reuss. | . | . | . | . | * | . | . | . | . | . | * |
| — <i>Macropora</i> , Bosq. | . | . | . | . | . | . | . | . | . | . | * |
| <i>Cythereis horrescens</i> , Bosq. | . | . | . | . | . | . | . | . | . | . | * |
| — <i>Ceratoptera</i> , Bosq. | . | . | . | . | . | . | . | . | . | . | * |
| — <i>cornuta</i> , Roem. | . | . | . | . | . | . | . | . | . | . | * |
| <i>Cytheridea Mulleri</i> , Münt. | . | . | . | * | . | . | * | . | * | * | * |
| — <i>perforata</i> , Roem. | . | . | . | . | . | * | * | . | * | * | * |
| <i>Bairdia subdeltoidea</i> , Münt. | . | . | * | . | . | * | . | . | * | * | * |
| <i>Cytherella compressa</i> , Münt. | * | . | . | . | . | ? | . | * | . | . | ? |
| — — <i>var. 1</i> | . | . | . | . | . | . | . | . | . | . | ? |
| — — <i>var. 2</i> | . | . | . | . | . | . | . | . | . | . | ? |
| — <i>Munsteri</i> , Roem. | . | . | . | . | . | . | . | . | . | ? | * |

NOTE.—The Nucula-bed (*N. deltoidea*) at Colwell Bay (mentioned at page 49 and elsewhere) contains *Cythere Colwellensis*, *C. debilis*, *C. angulato-pora*, *C. cornuta*, and *C. plicata*; the last-mentioned species presenting the most numerous individuals.

NOTE.—I have not been able to recognise among the London Clay specimens the species figured as *Cytherina barbata*, by Mr. Sowerby, in the 'Geological Transactions,' 2d series, vol. v, pl. 9, fig. 1. The specimen itself has been lost. It is possibly referable to *Cytheridea perforata*.

TABLE V.—*Showing the Succession of the English Upper Tertiaries (beneath the "Glacial beds"), and of their Correlation with those of the Neighbouring Countries.*

| | YORKSHIRE. | NORFOLK. | SUFFOLK. | BELGIUM. | FRANCE. | NETHERLANDS. |
|---------------|-------------------------|---|--|---|--|---------------|
| POST-PLIOCENE | Bridlington Crag. | Mammaliferous or Norwich Crag. ¹ | | | | |
| PLIOCENE. | {} | | Upper or Red Crag. ² Lower or Suffolk Crag. ³ | { Scaldisian Beds and Diest Sands. Bolderberg Sands. } | { Crag of Carentan, Normandy. Faluns of the Loire. } | Antwerp Crag. |
| MIOCENE. | ... | ... | ... | ... | ... | ... |

TABLE VI.—*Showing the Succession of the English Eocene Tertiaries, and of their Correlation with those of France and Belgium (after Prestwich and Lyell).*

| ISLE OF WIGHT AND HANTS. | LONDON DISTRICT. | BELGIUM. | FRANCE. |
|---|--|---|--|
| UPPER. { Hemstead Series. Bembridge Series. Osborne Series. Headon Series. Barton Clays (Highcliff, Barton, and L. of W.) } | | { Limburg Beds (Rupelian and Tongrian). Laecken Beds. Brussels Beds. } | { Beauce Limestone. Fontainebleau Sands. Marls with Ostrea cyathula. Marls and Gypsum. "Sables moyens," or Beauchamp Sands. Fresh-water Marls of the Calcaire grossier. Upper Calcaire grossier. Middle Calcaire grossier. Lower Calcaire grossier, or Glauconie grossiere. 1. Clays and Glauconiferous Sands. 2. Shell-beds. 3. Varied Sands, or Middle Glauconite. [London Clay; only at Dieppe.] ... } |
| MIDDLE. Upper Bracklesham Sands. Middle Bracklesham Sands. Lower Bracklesham Sands. ... | Upper Bagshot Sands. Middle Bagshot Sands. Lower Bagshot Sands. ... London Clay. Basement-bed of the London Clay. | Paniselian Beds. Upper Ypresian Beds. Lower Ypresian Beds. ... Upper Landenian Beds. Lower Landenian Beds. | { 4. Sandstones, pudding-stones, and shelly sands. 5. Sandy clays, oyster-beds, marls, lignite, plastic clay. 6. Lower Glauconite. ... } |
| LOWER. London Clay. ... Woolwich and Reading Series. ... | Woolwich and Reading Series. { Upper. Middle. Lower. } | | "Sables Inférieurs." |
| EOCENE. | Thanet Sands. | | |

¹ According to some observers, the Norwich Crag should not be separated either from the Red Crag below, or from the Glacial beds above.
² The Red Crag extends also through Suffolk to Walton-on-the-Naze, in Essex. The fresh-water deposits at Clacton, Stutton, and Grays Thimble, in Essex, are probably the fresh-water equivalents of the Upper Crag. See the Introduction to Mr. Wood's 'Monograph of the Crag Mollusca,' and for the age of the Crag-beds, Mr. Wood's 'Monog.' pp. 301, 302.
³ Known also as the Coralline Crag; but, as the characteristic organic remains in this deposit are neither Corallines nor Corals, but Sponges and Bryozoans, the term "Coralline" is manifestly a misnomer.

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¹ I have only just now seen this interesting Memoir [Nov. 1856]. Besides supplying us with the representative forms which Australia furnishes for comparison with the British species of Ostracoda, Mr. King figures and describes a highly interesting new generic form (*Newhamia*), differing from *Cypris* chiefly in having two eyes, and in peculiarities of the carapace, which has an horizontal ventral plate, a tuberculose surface, and two projecting, transparent (?), ocular tubercles (one for each eye). This is the only instance, except among palæozoic forms, of bivalved Entomostraca having ocular tubercles. The probable affinity, however, of

- LILJEBORG, W. De Crustaceis ex Ordinibus tribus, Cladocera, Ostracoda, et Copepoda in Scania occurrentibus. 8vo, Lund., 1853. Plates.
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these old genera to the Phyllopoda, rather than to the Lophypoda, is not invalidated by this discovery (as Mr. King seems inclined to think, *loc. cit.*, p. 61, note); since other and more important structural differences exist between the palæozoic bivalved Entomostraca and this eye-tubercled *Cypris* of Australia. See 'Annals Nat. Hist.,' 2d ser., 1856, vol. xvii, p. 97.

Mr. King places my *Cythereis* (as described and figured by Dr. Baird) in relation with his new genus *Newnhamia* (*loc. cit.*, p. 60), and thinks that they are "closely connected" by each having "two eyes and a very tuberculose shell." *Cythereis*, being probably a *Cythere*, may be supposed to have two eyes, but they are not evidenced externally; the little crystalline tubercles seen at the antero-dorsal angle of its valves, being related to the anterior hinge and to nothing else. The carapaces of *Newnhamia* and *Cythereis* differ widely also in all other characteristics, not excepting their style of tuberculation.

¹ This Memoir, treating of the Foraminifera and Entomostraca of the Oligocene deposits (Upper Eocene in Table VI, p. 62; Lower Miocene according to some authors) of Northern and Central Germany, has come to hand whilst this sheet is in the press [Nov. 1856].

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PLATE I.

Fig.

1. *Cypris Browniana*, p. 13.

| | | | | | | | |
|--|---|---|---|---|---|-----|----------|
| <i>a.</i> Left valve, outside | . | . | . | . | × | 25 | Clacton. |
| <i>b.</i> Right valve, inside | . | . | . | . | × | 25 | |
| <i>c.</i> Perfect carapace, dorsal aspect | . | . | . | . | × | 25 | |
| <i>d.</i> Perfect carapace, anterior aspect | . | . | . | . | × | 25 | |
| <i>e.</i> Part of the surface of right valve, with the lucid spots | . | . | . | . | × | 150 | |

2. *Cypris Browniana*, var. *tumida*, p. 13.

| | | | | | | | |
|---------------------------------------|---|---|---|---|---|----|--------|
| <i>a.</i> Perfect, left valve upwards | . | . | . | . | × | 25 | Grays. |
| <i>b.</i> Perfect, dorsal aspect | . | . | . | . | × | 25 | |

3. *Cypris gibba*, p. 15.

| | | | | | | | |
|--|-------------------|---|---|---|---|-----|-----------------|
| <i>a.</i> Right valve, outside | } Old individual. | . | . | . | × | 25 | Grays. |
| <i>b.</i> Right valve, inside | | . | . | . | × | 25 | |
| <i>c.</i> Perfect, dorsal aspect | . | . | . | . | × | 25 | Clacton. |
| <i>d.</i> Perfect, anterior aspect | . | . | . | . | × | 25 | |
| <i>e.</i> Right valve, outside. Young individual | . | . | . | . | × | 25 | Cambridgeshire. |
| <i>f.</i> Part of the surface of a valve | . | . | . | . | × | 150 | Grays. |

4. *Cypris Ovum*, p. 14.

| | | | | | | | |
|-----------------------------------|---|---|---|---|---|----|-----------------|
| <i>a.</i> Right valve, outside | . | . | . | . | × | 25 | Cambridgeshire. |
| <i>b.</i> Perfect, ventral aspect | . | . | . | . | × | 25 | |

5 *a.* *Candona candida* (variety with rosette-like lucid spots), p. 20.

| | | | | | | | |
|------------------------------|---|---|---|---|---|----|----------|
| Right valve, inside (broken) | . | . | . | . | × | 25 | Copford. |
|------------------------------|---|---|---|---|---|----|----------|

5 *b.* *Candona candida* (variety with lucid spots in a radiating form), p. 20.

| | | | | | | | |
|---|---|---|---|---|---|-----|----------|
| Part of inside of left valve, showing the lucid spots | . | . | . | . | × | 150 | Copford. |
|---|---|---|---|---|---|-----|----------|

6. *Cypris setigera*, p. 12.

| | | | | | | | |
|-------------------------------------|---|---|---|---|---|----|----------|
| <i>a.</i> Left valve, outside | . | . | . | . | × | 25 | Newbury. |
| <i>b.</i> Left valve, inside | . | . | . | . | × | 25 | |
| <i>c.</i> Perfect, dorsal aspect | . | . | . | . | × | 25 | |
| <i>d.</i> Perfect, posterior aspect | . | . | . | . | × | 25 | |

7. *Candona reptans*, p. 16.

| | | | | | | | |
|--|---|---|---|---|---|----|-------------------|
| <i>a.</i> Left valve, outside | . | . | . | . | × | 12 | Clacton. |
| <i>b.</i> Right valve, inside | . | . | . | . | × | 12 | Grays. |
| <i>c.</i> Perfect, dorsal aspect | . | . | . | . | × | 12 | Recent: Annerley. |
| <i>d.</i> Perfect, anterior aspect | . | . | . | . | × | 12 | |
| <i>e.</i> Part of inside of right valve, showing the lucid spots | . | . | . | . | × | 30 | Grays. |

PLATE I (*continued*).

Fig.

8. *Candona candida*, p. 19.

| | | | | |
|--|-------------------------|----|------------|-----|
| <i>a.</i> Left valve, outside | × | 25 | } Copford. | |
| [Imperfect at the posterior angle.] | | | | |
| <i>b.</i> Perfect, ventral aspect | × | 25 | | |
| <i>c.</i> Perfect, anterior aspect | × | 25 | | |
| <i>d.</i> Inside of the closed ventral edges of the carapace, showing the inner marginal plates | × | 25 | | |
| <i>e.</i> Part of the inside of the right valve, } | showing the lucid spots | × | | 150 |
| <i>f.</i> Part of the surface of the left valve, } | | × | | 150 |

9. *Candona subæqualis*, p. 20.

| | | | | | | | |
|--|---|---|---|---|---|----|------------|
| <i>a.</i> Perfect, right valve upwards | . | . | . | . | × | 25 | } Copford. |
| <i>b.</i> Perfect, dorsal aspect | . | . | . | . | × | 25 | |
| <i>c.</i> Perfect, posterior aspect | . | . | . | . | × | 25 | |

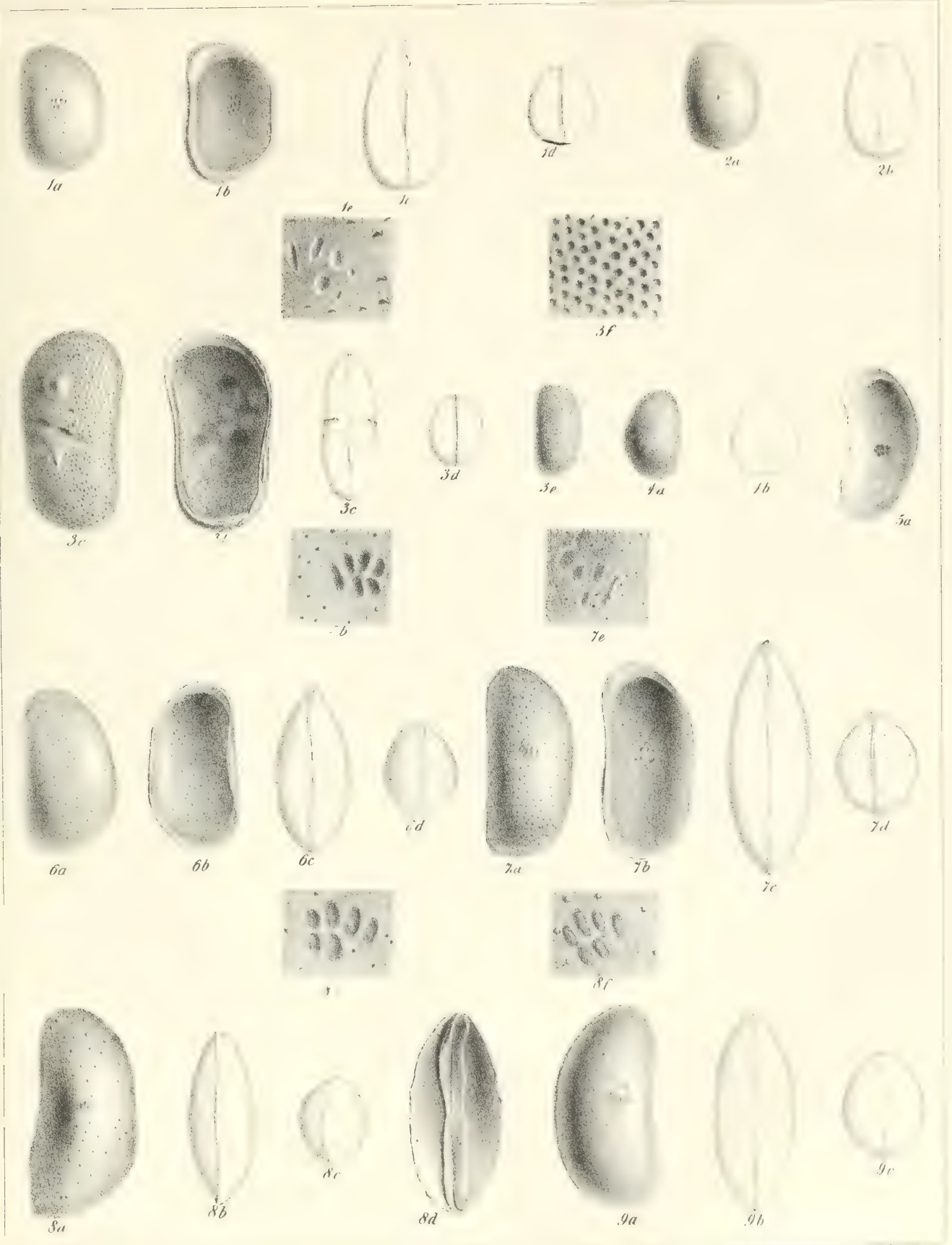


PLATE II.

Fig.

1. *Cyprideis torosa*, p. 21.

| | | | | | | | | |
|-------------------------------|-------|---|---|---|---|---|-----|----------|
| a. Left valve, outside. | } Old | . | . | . | . | × | 25 | } Grays. |
| b. Right valve, outside. | | . | . | . | . | × | 25 | |
| c. Perfect, dorsal aspect. | | . | . | . | . | × | 25 | |
| d. Perfect, posterior aspect. | | . | . | . | . | × | 25 | |
| e. Left valve, outside | . | . | . | . | . | × | 25 | |
| f. Right valve, outside | . | . | . | . | . | × | 25 | |
| g. Right valve, hinge-line | . | . | . | . | . | × | 50 | |
| h. Left valve, hinge-line | . | . | . | . | . | × | 50 | |
| i. Part of surface | . | . | . | . | . | × | 150 | |

2. *Cytherideis trigonalis*, p. 47.

| | | | | | | | |
|---|---|---|---|---|---|-----|----------|
| a. Perfect, left valve upwards | . | . | . | . | × | 12 | Grays. |
| b. Left valve, dorsal view | . | . | . | . | × | 12 | Clacton. |
| c. Right valve, inside | . | . | . | . | × | 12 | } Grays. |
| d. Left valve, anterior hinge | . | . | . | . | × | 50 | |
| e. Left valve, posterior hinge | . | . | . | . | × | 50 | |
| f. Left valve, inside | . | . | . | . | × | 12 | |
| g. Part of inside of right valve, showing lucid spots | . | . | . | . | × | 30 | |
| h. Part of surface of valve | . | . | . | . | × | 150 | |

3. *Cytherideis tuberculata*, p. 47.

| | | | | | | | |
|--------------------------------|---|---|---|---|---|----|---------|
| a. Left valve, inside (broken) | . | . | . | . | × | 25 | } Crag. |
| b. Left valve, hinge-line | . | . | . | . | × | 25 | |
| c. Left valve, dorsal view | . | . | . | . | × | 25 | |
| d. Perfect, dorsal view | . | . | . | . | × | 25 | |
| e. Left valve, outside | . | . | . | . | × | 25 | |
| f. Left valve, inside | . | . | . | . | × | 25 | |

4. *Cytheridea pinguis*, p. 43.

| | | | | | | | |
|--|---|---|---|---|---|-----|---------|
| a. Perfect, right valve upwards | . | . | . | . | × | 25 | } Crag. |
| b. Perfect, posterior aspect | . | . | . | . | × | 25 | |
| c. Perfect, dorsal aspect (young or male) | . | . | . | . | × | 25 | |
| d. Perfect, dorsal aspect (old or female) | . | . | . | . | × | 25 | |
| e. Right valve, inside | . | . | . | . | × | 25 | |
| f. Left valve, inside | . | . | . | . | × | 25 | |
| g. Portion of surface of 4 c, with papillæ and fine pits | . | . | . | . | × | 150 | |
| h. Portion of surface of 4 b, with pits | . | . | . | . | × | 150 | |

5. *Cythere punctata*, p. 24.

| | | | | | | | |
|---|---|---|---|---|---|-----|---------|
| a. Left valve, outside (broken at posterior end, old) | . | . | . | . | × | 25 | } Crag. |
| b. Right valve, outside | . | . | . | . | × | 25 | |
| c. Perfect, dorsal aspect | . | . | . | . | × | 25 | |
| d. Perfect, anterior aspect | . | . | . | . | × | 25 | |
| e. Left valve, inside (young) | . | . | . | . | × | 25 | |
| f. Left valve, inside | . | . | . | . | × | 25 | |
| g. Right valve, inside | . | . | . | . | × | 25 | |
| h. Part of surface of valve | . | . | . | . | × | 150 | |

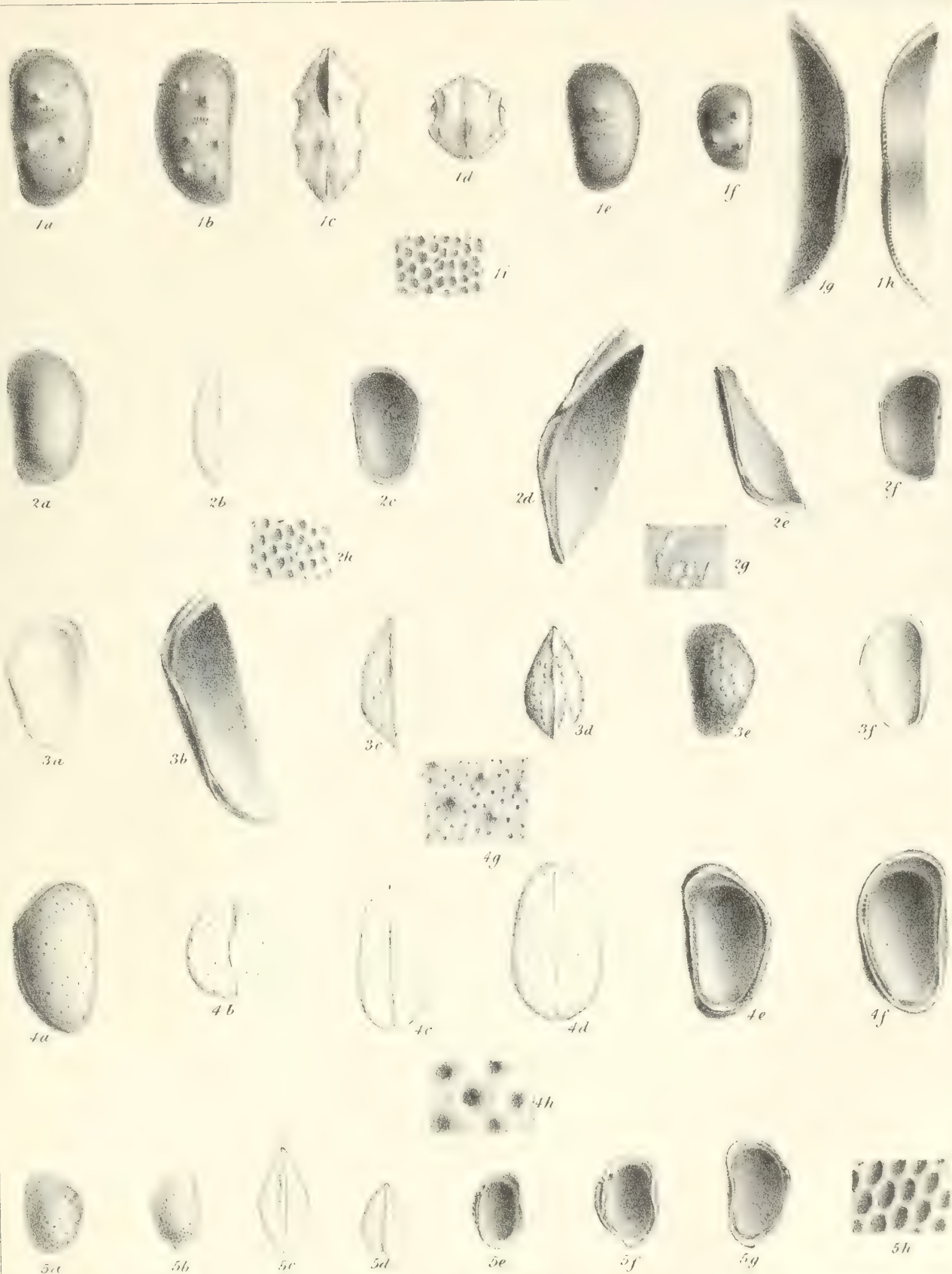


PLATE III.

Fig.

1. *Cythere trigonula*, p. 25.

| | | | | | |
|---------------------------------|---|---|---|-------|---------|
| a. Perfect, right valve upwards | . | . | . | × 25 | |
| b. Perfect, dorsal view | . | . | . | × 25 | |
| c. Perfect, anterior view | . | . | . | × 25 | |
| d. Right valve, dorsal view | . | . | . | × 25 | } Crag. |
| e. Right valve, inside | . | . | . | × 25 | |
| f. Left valve, inside | . | . | . | × 25 | |
| g. Left valve, dorsal view | . | . | . | × 25 | |
| h. Portion of surface of valve | . | . | . | × 150 | |

2. *Cythere Woodiana* (old individuals), p. 29.

| | | | | | |
|--------------------------------|---|---|---|-------|---------|
| a. Left valve, outside | . | . | . | × 25 | } Crag. |
| b. Right valve, outside | . | . | . | × 25 | |
| c. Perfect, dorsal view | . | . | . | × 25 | |
| d. Perfect, anterior view | . | . | . | × 25 | |
| e. Left valve, hinge-line | . | . | . | × 25 | |
| f. Right valve | . | . | . | × 25 | |
| g. Portion of surface of valve | . | . | . | × 150 | |

3. *Cythere laqueata*, p. 30

| | | | | | |
|--------------------------------|---|---|---|-------|---------|
| a. Right valve, outside | . | . | . | × 25 | } Crag. |
| b. Perfect, dorsal view | . | . | . | × 25 | |
| c. Perfect, anterior view | . | . | . | × 25 | |
| d. Left valve, dorsal view | . | . | . | × 25 | |
| e. Left valve, hinge-line | . | . | . | × 25 | |
| f. Right valve, hinge-line | . | . | . | × 25 | |
| g. Right valve, dorsal view | . | . | . | × 25 | |
| h. Portion of surface of valve | . | . | . | × 150 | |

4. *Cytherideis Tamarindus*, p. 49.

| | | | | | |
|---|---|---|---|------|---------|
| a. Perfect, left valve upwards | . | . | . | × 25 | } Crag. |
| [The faint reticulate punctation is not shown in the figure.] | | | | | |
| b. Perfect, dorsal aspect | . | . | . | × 25 | |

5. *Cythere lacunosa*, p. 31.

| | | | | | |
|----------------------------|---|---|---|------|---------|
| a. Right valve, outside | . | . | . | × 25 | } Crag. |
| b. Perfect, ventral aspect | . | . | . | × 25 | |

6. *Cythere sphærololineata*, p. 36.

| | | | | | |
|----------------------|---|---|---|------|-------|
| Right valve, outside | . | . | . | × 25 | Crag. |
|----------------------|---|---|---|------|-------|

7. *Cythere retifastigata*, p. 36.

| | | | | | |
|--------------------------------------|---|---|---|------|-------|
| Left valve, outside (old individual) | . | . | . | × 25 | Crag. |
|--------------------------------------|---|---|---|------|-------|

PLATE III (*continued*).

Fig.

8. *Cythereis senilis*, p. 37.

| | | | | | | |
|--------------------------------|---|---|---|---|------|---------|
| a. Right valve, outside | . | . | . | . | × 25 | } Crag. |
| b. Right valve, ventral aspect | . | . | . | . | × 25 | |

9 a—e. *Cythere Macropora*, p. 35.

| | | | | | | |
|--------------------------------|---|---|---|---|------|---------|
| a. Right valve, outside | . | . | . | . | × 25 | } Crag. |
| b. Perfect, ventral aspect | . | . | . | . | × 25 | |
| c. Perfect, dorsal aspect | . | . | . | . | × 25 | |
| d. Perfect, anterior aspect | . | . | . | . | × 25 | |
| e. Left valve, outside (young) | . | . | . | . | × 25 | |

9 f—i. *Cythere Trachypora*, p. 36.

| | | | | | | |
|------------------------------|---|---|---|---|------|---------|
| f. Left valve, dorsal aspect | . | . | . | . | × 25 | } Crag. |
| g. Left valve, inside | . | . | . | . | × 25 | |
| h. Right valve, inside | . | . | . | . | × 25 | |
| i. Left valve, dorsal aspect | . | . | . | . | × 25 | |



PLATE IV.

Fig.

1. *Cythereis Ceratoptera*, p. 39.

Left valve, outside × 25 Crag.

2, 3. *Bairdia subdeltoidea*, p. 52.

2 a. Left valve, outside × 12
 2 b. Portion of surface, showing the lucid spots and fine papillæ × 75 } Crag.
 3. Right valve, inside (small individual) × 12

4. *Cytherideis flavida*, p. 50.

a. Right valve, outside (narrow var.) × 25
 b. Perfect, dorsal aspect × 25 } Crag.
 c. Perfect, end view × 25

5. *Cytherideis Ren*, p. 51.

a. Left valve, outside × 25
 b. Left valve, dorsal view × 25 } Crag.

6. *Cytheridea Sorbyana*, p. 44.

a. Right valve, outside × 25
 b. Right valve, ventral view × 25
 c. Right valve, anterior view × 25 } Bridlington.
 d. Left valve, hinge-line × 55
 e. Part of surface, showing reticulations and perforations . . . × 150

7. *Cythere concinna*, p. 29.

a. Right valve, outside × 25
 b. Right valve, ventral view × 25
 c. Right valve, anterior view × 25
 d. Right valve, hinge-line × 25 } Bridlington.
 e. Left valve, hinge-line × 25
 f. Part of surface, showing pittings and perforations . . . × 150

8, 9, 11. *Candona Forbesii*, p. 18.

8. Right valve, outside (somewhat distorted) × 12
 9. Left valve, outside × 12 } Cliff End.
 11 a. Right valve, outside × 12
 18 b. Right valve, ventral view × 12 } Hordwell.

10. *Cytherideis unisulcata*, p. 48.

Cast of right valve × 16 Cliff End.

12. *Candona Richardsoni*, p. 18.

a. Left valve, outside × 25
 b. Left valve, ventral view × 25 } Woolwich.

PLATE IV (*continued*).

Fig.

13, 20. *Cytherideis Colwellensis*, p. 49

| | | | | | | |
|---------------------------------|---|---|---|---|----|--------------|
| 13 a. Right valve, outside | . | . | . | × | 25 | Colwell Bay. |
| 13 b. Perfect, dorsal aspect | . | . | . | × | 25 | |
| 13 c. Perfect, posterior aspect | . | . | . | × | 25 | |
| 20 a. Left valve, outside | . | . | . | × | 25 | |
| 20 b. Left valve, dorsal aspect | . | . | . | × | 25 | |
| 20 c. Left valve, hinge-line | . | . | . | × | 25 | |

14. *Cytheridea perforata*, p. 44.

| | | | | | | |
|----------------------------|---------|---|---|---|----|--------------|
| a. Left valve, outside | . | . | . | × | 25 | Colwell Bay. |
| b. Left valve, dorsal view | . | . | . | × | 25 | |
| c. Right valve, hinge-line | . | . | . | × | 25 | |
| d. Left valve, outside | } Young | . | . | × | 25 | |
| e. Perfect, dorsal aspect | | . | . | × | 25 | |

15. *Cythere Wetherellii*, p. 26.

| | | | | | | |
|----------------------|---|---|---|---|----|--------------|
| Right valve, outside | . | . | . | × | 25 | Colwell Bay. |
|----------------------|---|---|---|---|----|--------------|

16. *Cythere plicata*, p. 32.

| | | | | | | |
|---------------------|---|---|---|---|----|--------------|
| Left valve, outside | . | . | . | × | 25 | Colwell Bay. |
|---------------------|---|---|---|---|----|--------------|

17, 18. *Cythere angulatopora*, p. 34.

| | | | | | | |
|---|---------------------|---|---|---|----|----------------|
| 17. Left valve, outside | . | . | . | × | 25 | } Colwell Bay. |
| [The ornamentation is not drawn strong enough.] | | | | | | |
| 18 a. Perfect, dorsal aspect | } Large individuals | . | . | × | 25 | |
| 18 b. Perfect, anterior aspect | | . | . | × | 25 | |

19. *Cythereis cornuta*, p. 39.

| | | | | | | |
|---------------------|---|---|---|---|----|--------------|
| Left valve, outside | . | . | . | × | 25 | Colwell Bay. |
|---------------------|---|---|---|---|----|--------------|

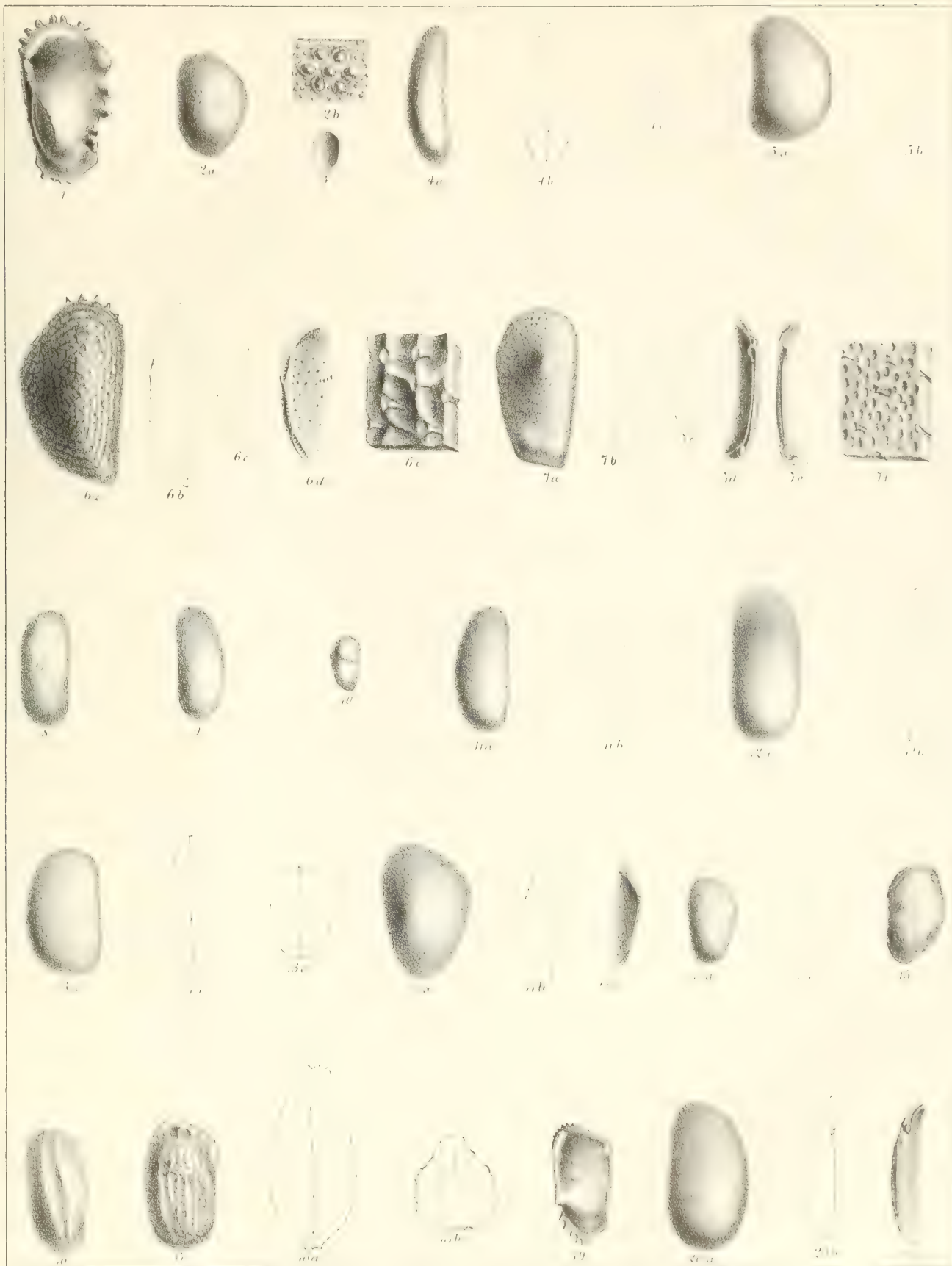


PLATE V.

Fig.

1. *Bairdia contracta*, p. 53.

| | | | | | |
|---------------------------------|---|---|---|------|-----------------|
| a. Right valve, inside | . | . | . | × 25 | } Barton Cliff. |
| b. Perfect, dorsal aspect | . | . | . | × 25 | |
| c. Perfect, right valve upwards | . | . | . | × 25 | |

2, 3. *Cytherideis Bartonensis*, p. 50.

| | | | | | |
|---------------------------------|---|---|---|------|-----------------|
| 2 a. Right valve, outside | . | . | . | × 25 | } Barton Cliff. |
| 2 b. Right valve, dorsal aspect | . | . | . | × 25 | |
| 3 a. Right valve, outside | . | . | . | × 25 | |
| 3 b. Perfect, dorsal aspect | . | . | . | × 25 | |

4, 5. *Cytheridea Mulleri*, var. *intermedia*, p. 42.

| | | | | | |
|---|---|---|---|------|-----------------|
| a. Perfect, right valve upwards | . | . | . | × 25 | } Barton Cliff. |
| b. Perfect, dorsal aspect | . | . | . | × 25 | |
| c. Perfect, posterior aspect | . | . | . | × 25 | |
| 5. Right valve, outside : young (crushed) | . | . | . | × 25 | |

6, 7, 10. *Cythere striatopunctata*, p. 27.

| | | | | | |
|----------------------------------|---|---|---|------|------------------------|
| 6. Right valve, outside : young | . | . | . | × 25 | } Barton Cliff. |
| 7 a. Perfect, left valve upwards | . | . | . | × 25 | |
| 7 b. Perfect, dorsal view | . | . | . | × 25 | |
| 7 c. Perfect, anterior view | . | . | . | × 25 | |
| 10. Right valve, outside | . | . | . | × 25 | Alum Bay (Bed No. 29). |

8. *Cythere plicata*, var. *Laticosta*, p. 33.

| | | | | | |
|-----------------------------|---|---|---|------|-----------------|
| a. Left valve, outside | . | . | . | × 25 | } Barton Cliff. |
| b. Right valve, inside | . | . | . | × 25 | |
| c. Perfect, dorsal aspect | . | . | . | × 25 | |
| d. Perfect, anterior aspect | . | . | . | × 25 | |

9, 17. *Cythereis horrescens*, p. 38.

| | | | | | |
|------------------------|---|---|---|------|---------------|
| 9. Left valve, outside | . | . | . | × 25 | Barton Cliff. |
|------------------------|---|---|---|------|---------------|

[The ornament on the surface should have been figured as blunt spines, not tubercles.]

| | | | | | |
|------------------------------------|---|---|---|------|--------------------|
| 17 a. Left valve, outside : broken | . | . | . | × 25 | } Bracklesham Bay. |
| 17 b. Left valve, dorsal aspect | . | . | . | × 25 | |

11. *Cythere attenuata*, p. 28.

| | | | | | |
|---|---|---|---|------|------------------------|
| Left valve, outside : broken at the antero-dorsal hinge | . | . | . | × 25 | Alum Bay (Bed No. 29). |
|---|---|---|---|------|------------------------|

[The subcentral impression towards the dorsal border is not shown in this figure.]

12, 13. *Cytherella Munsteri*, p. 56.

| | | | | | |
|--|---|---|---|------|--------------------|
| 12 a. Left valve, outside | . | . | . | × 25 | } Bracklesham Bay. |
| 12 b. Left valve, dorsal aspect | . | . | . | × 25 | |
| [The posterior extremity is too acute in this figure.] | | | | | |
| 13. Left valve, outside | . | . | . | × 25 | |

PLATE V (*continued*).

Fig.

14. *Cythere costellata*, p. 32.

Left valve, outside × 25 Bracklesham Bay.

15. *Cythereis cornuta*, p. 39.

a. Right valve, outside × 25 }
b. Right valve, dorsal aspect × 25 } Bracklesham Bay.

16. *Cythere scabropapulosa*, p. 31.

Right valve, outside × 25 Bracklesham Bay.

18, 19, 21, 23. *Cytherella compressa*, p. 54.

18. Left valve, outside. (Var. 1, p. 55.) × 25 }
19. Left valve, outside. (Var. 2, p. 55.) × 25 } Copenhagen Fields,
21. Right valve, outside. (Large individual.) × 25 } London.
23. Right valve, outside × 25 }

20, 22. *Cytherella Londinensis*, p. 55.

20. Left valve, outside × 25 } Copenhagen Fields,
22. Right valve, outside × 25 } London.

[The central depression is not sufficiently well marked in either of these figures.]

24. *Cytheridea perforata*, var. *glabra*, p. 46.

a. Right valve, outside × 25 } Copenhagen Fields,
b. Right valve, dorsal view × 25 } London.



1a



1b



1c



2a

2b



3a

3b



4a



4b



4c



5



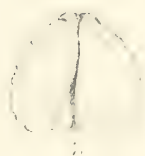
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7a



7b



8



9a



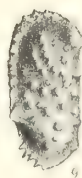
9b



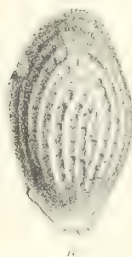
9c



10



11



12



13



14a



14b



15



16



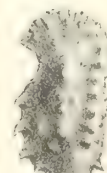
17a



17b



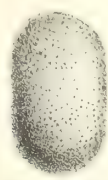
18



19



20



21



22



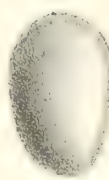
23



24



25



26



27

28

PLATE VI.

Fig.

- | | | | | | |
|--|---|---|---|------|-------------------------------|
| 1, 2. <i>Bairdia subdeltoidea</i> , p. 52. | | | | | |
| 1 a. | Perfect, right valve upwards | . | . | × 25 | Copenhagen Fields, London. |
| 1 b. | Perfect, dorsal aspect | . | . | × 25 | |
| 2. | Perfect, right valve upwards. (Showing denticulations at the anterior and posterior margins.) | . | . | × 25 | |
| 3. <i>Cytheridea perforata</i> , var. <i>insignis</i> , p. 46. | | | | | |
| a. | Right valve, outside: imperfect | . | . | × 25 | Copenhagen Fields, London. |
| b. | Right valve, posterior aspect | . | . | × 25 | |
| c. | Right valve, dorsal aspect | . | . | × 25 | |
| 4, 6. <i>Cythere scrobiculoplicata</i> , p. 33. | | | | | |
| 4. | Left valve, outside | . | . | × 25 | Copenhagen Fields, London. |
| 6 a. | Left valve, outside | . | . | × 25 | |
| 6 b. | Left valve, hinge-line | . | . | × 25 | |
| 6 c. | Right valve, hinge-line | . | . | × 25 | |
| 6 d. | Perfect, dorsal aspect | . | . | × 25 | |
| 5. <i>Cythere triangularis</i> , p. 25. | | | | | |
| a. | Left valve, outside | . | . | × 25 | Copenhagen Fields, London. |
| b. | Left valve, dorsal view | . | . | × 25 | |
| c. | Left valve, hinge-line | . | . | × 25 | |
| d. | Perfect, anterior aspect | . | . | × 25 | |
| e. | Right valve, hinge-line | . | . | × 25 | |
| f. | Right valve, dorsal aspect | . | . | × 25 | |
| g. | Right valve, outside | . | . | × 25 | |
| 7, 8. <i>Cythereis Bowerbankiana</i> , p. 38. | | | | | |
| 7. | Left valve, outside | . | . | × 25 | Copenhagen Fields, London. |
| 8. | Left valve, outside | . | . | × 25 | |
| 9. <i>Cythere scrobiculoplicata</i> , var. <i>recta</i> , p. 34. | | | | | |
| | Left valve, outside | . | . | × 25 | East Woodhay, Hampsh. |
| 10, 11. <i>Cytheridea Mulleri</i> , p. 41. | | | | | |
| 10 a. | Left valve, outside | . | . | × 25 | Colwell Bay. ¹ |
| 10 b. | Perfect, dorsal aspect | . | . | × 25 | |
| 11. | Left valve, outside | . | . | × 25 | Woolwich. |
| 12. <i>Cytheridea Mulleri</i> , var. <i>torosa</i> , p. 42. | | | | | |
| | Right valve, outside | . | . | × 25 | Woolwich. |

¹ This and the subsequent figures of species from Colwell Bay were introduced among the Woolwich species under the mistake explained at p. 26.

PLATE VI (continued).

Fig.

13. *Cytheridea debilis*, p. 43.

Left valve, outside × 25 Colwell Bay.

14. *Cythere Kostelensis* ? p. 28.

14 a. Left valve, outside × 25 }
14 b. Perfect, dorsal aspect × 25 } Woolwich.

15. *Cytherideis* ? sp., p. 49.

Cast of left valve × 12 New Cross.

16. *Cythere Wetherellii*, p. 26.

a. Left valve, outside × 25 }
b. Right valve, hinge-line × 25 } Colwell Bay.
c. Right valve, dorsal aspect × 25 }
d. Right valve, posterior aspect × 25 }

17. *Cythere plicata*, p. 32.

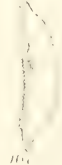
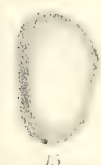
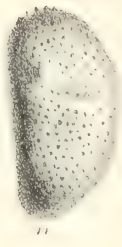
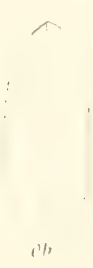
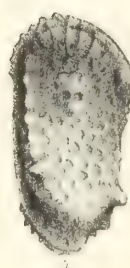
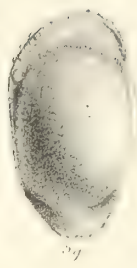
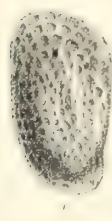
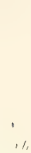
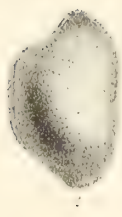
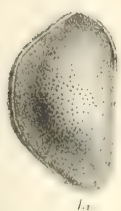
Left valve, outside × 25 Colwell Bay.

18. *Cythere angulatopora*, p. 34.

Left valve, outside: broken × 25 Colwell Bay.

19. *Cythereis*, sp., p. 40.

Fragment of left valve × 25 Pegwell Bay.



THE
PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLV.

A MONOGRAPH

ON THE

BRITISH FOSSIL

ECHINODERMATA

OF

THE OOLITIC FORMATIONS.

BY

THOMAS WRIGHT, M.D., F.R.S.E.

PART FIRST,

CONTAINING

THE CIDARIDÆ, HEMICIDARIDÆ, AND DIADEMADÆ.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

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J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

PREFACE.

IN presenting the First Part of my Monograph on 'British Fossil Echinodermata' to the members of the Palæontographical Society, I deem it necessary to make a few remarks in order to explain—1st, how I came to occupy the position of an author in the magnificent volumes published by your Society; and 2dly, to state the manner in which I have endeavoured to discharge the duties of the task I have undertaken.

After the publication of my 'Memoirs on the Echinodermata of the Oolites,'* in the 'Annals of Natural History,' my much lamented friend, the late Professor Edward Forbes, as a member of your Council, asked me to contribute a Monograph on the same subject to the Palæontographical Society. Knowing that he had in preparation a supplementary chapter on the Echinoderms of the Great Oolite, for Messrs. Morris and Lycett's Monograph on the Mollusca of that Formation, I thanked him for the good opinion he had formed of my ability for such a work, but declined, lest, by complying with his request, I might possibly have interfered with any intentions of his own on the subject, knowing how ardently he loved all that related to this class of the Animal Kingdom. As Professor Forbes, however, on another occasion, renewed, in the most pressing manner, his solicitation, I then proposed to join him in a Monograph on the British Fossil Echinodermata of the Secondary Formations, which he at once agreed to, and the proposal for this joint work was submitted to the approval of your Council, and received its sanction.

The numerous and constantly increasing duties of my esteemed colleague at the School of Mines prevented him from taking any share in the collection of materials for the preparation of the Monograph on the Oolitic Echinodermata, and, with his usual candour, he told me that, as he was unable, from want of time, to contribute to this division of our proposed joint work, his name must be withdrawn from its title page; and, if agreeable to me, that I should undertake the Monograph on the Oolitic species, whilst he would devote himself to the description of the Cretaceous forms. After this arrangement, I directed my attention with redoubled energy to the subject of my special studies.

On his appointment to the chair of Natural History in the University of Edinburgh, Professor Forbes took with him the materials for the first part of his promised Monograph

* 'Annals and Magazine of Natural History,' new series, vol. viii, 1851.

on the Cretaceous Echinoderms; but, alas! his untimely and much-lamented death prevented him from even commencing that work upon which his mind had been so long and busily engaged, and which was looked forward to with so much interest by all who knew the high qualifications of my friend for his selected task. But the mysterious decrees of Providence disappointed our expectations, and at the same time deprived Natural Science, in this country, of one of its brightest ornaments and warmest advocates. It would be doing violence to my own feelings if I did not, on this occasion, record the high estimation in which I held the opinions of my distinguished colleague on all points relating to the work we had undertaken together, and the uniform deference I paid to his suggestions, as to the best mode of executing the same, which were always dictated by that kindness, frankness, and wisdom so characteristic of the man.

Having been thus thrown entirely on my own resources, before the real difficulties of the work began, I have experienced more than ever the deep responsibility of the task I have undertaken. I trust the circumstances I have narrated will entitle me to the consideration and indulgence of all who know the nature and amount of the difficulties to be grappled with in a work like that in which I am engaged, and the time and labour necessary to overcome them. I can only add, that I have spared neither time, labour, nor research, in order to make this Monograph worthy of the confidence originally reposed in me; but how far I may have succeeded in my efforts, it remains for others to decide.

At the suggestion of my excellent friend, Thomas Davidson, Esq., author of the magnificent Monograph on the Brachiopoda, and several other kind friends interested in the success of this work, it was thought advisable that, at the conclusion of my Monograph on the Oolitic species, I should proceed with the description of the Cretaceous forms, in order that a greater unity in the arrangement and management of the subject might be observed in the two Monographs on the Echinodermata of the Secondary rocks; and a proposal to this effect has been submitted to your Council, and received its sanction.

I have ventured to propose some important alterations in the classification of the Echinoidea, and have grouped the genera into thirteen natural families, many of which are entirely new. My object has been to attain a more natural method, and thereby facilitate the study of the different groups. I have given an analysis of these families at the commencement of the work, and enumerated the most common types of each.

In the description of the species, I have taken them in their stratigraphical order, always commencing with the species found in the oldest rock in which the genus is discovered, thus — *a*, Lias, Lower, Middle, and Upper; *b*, Inferior Oolite; *c*, Great Oolite, including Fullers-earth, Stonesfield Slate, Great Oolite, Bradford Clay, Forest Marble, and Cornbrash; *d*, Oxford Clay; *e*, Coralline Oolite, including Calcareous Grit, and Coral Rag; *f*, Kimmeridge Clay; *g*, Portland Oolite; *h*, Purbeck Beds;—so that my work has the double advantage of being stratigraphical and palæontological at the same time, a mode of treating the subject which I hope will prove useful and convenient to geologists.

Many of the readers of this Monograph will probably be surprised to find some old generic names reproduced, which have long been superseded by those of modern writers; but a sense of justice to such authors as Van Phelsum, Breynius, Klein, and Leske, has led me to consult their original works, and restore the genera first described and figured by them, but omitted from the treatises of later authors on the same subject. In the nomenclature of the Echinodermata, had I merely gone back to the time of Linnæus, as suggested by the committee of the British Association in their report made in 1842, I must necessarily have excluded the important work by Breynius,* in which, for the first time, were proposed seven well-described and accurately figured genera of Echinoidea, which, by some strange oversight, were not adopted by his contemporaries, although they have reappeared under new names in the works of later authors. On the principle of priority, therefore, I have restored the original genera so clearly defined by Breynius, even although it may occasion a temporary inconvenience in the names of some well-known forms of urchins.

In every case, where practicable, the name of the author who either first recorded, described, or figured the species, follows the specific name of the object, without the addition of "Sp." adopted by some authors. By this mode justice is done to the original author, and confusion avoided. The modern practice of inventing and changing generic names, and appending to the old specific name that of the individual who has merely changed a name, but discovered nothing, cannot be sufficiently discountenanced, as it greatly increases the confusion arising from an already overloaded synonymy, and thereby retards the real progress of the natural history sciences.

The accurate determination of species, and their distribution in time and space, form problems of the highest importance to the palæontologist, as their true solution are the only certain guides of the geologist in his investigations in the field, and his generalizations in the study: for the classification of strata, the subdivision of rock groups, and the boundary lines between different formations, are all points which are more or less affected by the soundness of his conclusions.

In determining the species of Echinodermata, therefore, the most careful comparison has been made with the true type forms to which they are referred, and the extent of the section in the description of the species, on the affinities and differences exhibited by each with other Foreign and British congeneric forms, will show how much care has been taken to arrive at a correct determination.

The range and stratigraphical position of the species described in this work has occupied much time and attention, as many errors found in previous lists of Oolitic Echinodermata required considerable research to correct; for experience has taught me that, unless the palæontologist can verify for himself the statements of his collectors, he will frequently be led into similar errors. In every instance, with the exception of the Northamptonshire beds, which have been carefully noted by my friend the

* De Echinis et Echinitis, sive Methodica Echinorum distributione, Schediasma. Gedani, 1732.

Rev. A. W. Griesbach, I have visited the different localities given in this work, and with my own hammer ascertained the presence of the species in the rock whence they are stated to be obtained ; the most perfect confidence may therefore be placed in the notes on the stratigraphical distribution of the species, as the greatest care has been taken in order to arrive at the truth.

As the Oolitic rocks of Europe were deposited in basins of greater or less extent, it follows that many contemporary species which lived on different shores of these ancient seas will, from time to time, be discovered ; and Foreign species, hitherto found only in the Oolitic rocks of the Continent, will doubtless be discovered in strata of the same age in England, and *vice versâ*. I have, therefore, at the end of the description of the species of each genus, for the purpose of easy reference in the event of new species being found, appended original notes on Foreign Oolitic species of that genus most nearly allied to our own forms, but which have not as yet been found in the English Oolites. The Foreign species are printed in a different type, and the notes are placed at the end of the section to which they belong. The short diagnosis I have given of each species is drawn from authentic specimens kindly contributed by several distinguished foreign friends, whose names are mentioned in connection with their specimens. A reference is made to the best figures of each species extant ; and for the localities in which they are found, and the collections in which the types are contained, I have consulted with much advantage M. Desor's excellent 'Synopsis des Échinides Fossiles,' now in course of publication.

It is now my pleasing duty to return my most sincere thanks, either for the loan of specimens, or permission to inspect their collections in quest of new forms, to Mr. Pickering and Mr. King, Malton ; Mr. Charlesworth, York ; Mr. Waite and Mr. Duck, Calne ; Mr. William Buy, Sutton ; Mr. Bean, Scarborough ; the Hon. Mr. Marcham ; Mr. H. C. Sorby ; Mr. W. Cunnington, Devizes ; Mr. Walton and Mr. Bush, Bath ; Mr. Mackneil, Wotton-under-Edge ; the Rev. P. B. Brodie, Rowington Vicarage, near Warwick ; Mr. John Lycett, Minchinhampton ; Mr. John Jones, Gloucester ; Professor Buckman and Mr. Bravender, Cirencester ; Professor Morris, Professor Tennant, and Mr. J. S. Bowerbank, London ; Mr. W. M. Tarrt, Mr. Charles Pierson, Mr. Thomas Bodley, and Mr. Edward Hull, F.G.S., Geological Survey, Cheltenham.

I beg to tender my especial thanks to the Rev. A. W. Griesbach, of Wollaston, for several valuable contributions, consisting of many fine series of different species of Echinoderms from the Great Oolite, Forest Marble, and Cornbrash of Northamptonshire, likewise for the labour he has bestowed in finding some rare species, and ascertaining many valuable facts relative to the distribution of the species found in his county ; to Mr. J. Graham Lowe, Kensington Park, for the gift of *Pygaster umbrella*, Lamk., from the Coral Rag ; and to Mrs. Lowe for the gift of the rare *Asterostoma excentricum*, Agass. ; to Dr. Symes, Bridport, for a fine *Clypeus Agassizii*, from the Inferior Oolite of Chideock ; to Mr. Charles Moore, Bath, for the gift of some rare specimens from the

Upper Lias of Ilminster; to Mr. Etheridge, Bristol, for several rare urchins; to Mr. G. E. Gavey, C.E., for the donation of several fine CRINOIDEA and ASTEROIDEA, from the Middle Lias of Chipping-Campden, and for the loan of his finest specimens for figuring in this work; to the Earl of Ducie, for the loan of his unique *Solaster Moretonis*, Forbes, and several fine Cretaceous Cidarid and Star Fishes; to Mr. John Leckenby, Scarborough, for much useful information relative to the distribution of the Yorkshire Oolitic Echinodermata, and for the gift of several specimens; to Dr. Murray, Scarborough, for the donation of several rare Coralline Oolite *Pygasters* and *Pyguri*, collected by him at Ayton; to Mr. Reed, York, for much valuable information regarding the Whitwell beds of Inferior Oolite, and for the gift of type specimens of *Pygaster semisulcatus*, Phil., and *Echinus germinans*, Phil.; to Mr. Wood, Richmond, Yorkshire, for the gift of fine specimens of *Echinobrissus orbicularis*, Phil., *Echinobrissus dimidiatus*, Phil., and *Woodocrinus macrodactylus*, de Koninck, and for kindly placing his beautiful collection of CRINOIDEA at my disposal; to Mr. Charles Fowler, Cheltenham, for the gift of *Cidarid Fowleri*; to Mr. Davidson, of Brighton, for the uniform interest he has taken in the success of this work, for the specimens he has contributed, the manuscript plates he has lent, and the introductions he has given me to several distinguished Continental naturalists, who have kindly supplied much useful information.

I desire to make my warmest acknowledgments to M. Michelin, of Paris, who possesses the finest collection extant of living and fossil Echinodermata, for the magnificent series of type specimens he most generously contributed to my cabinet for comparison with English forms; to M. Bouchard-Chantreaux, of Boulogne, for a series of Echinoderms from the Oolitic rocks of the Boulonnais; to M. Cotteau, of Coulommiers, for the types of the species described by him in his 'Études sur les Échinides Fossiles du département de l'Yonne;' to M. Triger, of le Mans, for a suite of specimens collected by him from the Oolites in the département de la Sarthe; to Professor Deslongchamps, of Caen, for the specimens collected by him from the Oolites of Calvados, and determined by M. Agassiz; to M. de Lorière, of Paris, for many rare urchins from the département de la Sarthe; to Professor Roemer, for the types of several of his brother's species from the Oolites of Hanover; to Dr. Fraas, of Stuttgart, for the types of many of Count Münster and Professor Goldfuss's species from the Royal Museum of Württemberg; to Professor de Koninck, of Liège, Dr. Oppel, of Stuttgart, and M. Sæmann, of Paris, for good types of many Foreign species.

My warmest thanks are likewise due to my friend Mr. S. P. Woodward, of the British Museum, for kindly acting as my referee in the prosecution of this work, and for the many valuable suggestions he has made during its preparation and progress, as well as for the assistance he has given me in comparing my specimens with Foreign types in the British Museum, and aiding in the determination of dubious forms.

The late Sir Henry de la Beche, Director-General of the Geological Survey of Great Britain, most liberally gave me free access to all the specimens contained in the Geological

Museum in Jermyn Street ; and the same privilege has been most kindly renewed by his distinguished successor, Sir Roderick I. Murchison, to whom I beg to tender my warmest acknowledgments. I am under many obligations to my friend Mr. Waterhouse, of the British Museum, for his kindness in allowing me to examine all the Echinoderms in the National Collection, and his permission to figure those I have selected for this purpose. Professor Sedgwick, of Cambridge University, at my request, most liberally communicated the types of Professor M'Coy's new species of urchins, described in the 'Annals of Natural History.' Mr. Rupert Jones has at all times given me free admission to examine the rich cabinets of the Geological Society of London. Professor Phillips, of Oxford, has afforded me much useful information relative to the species of Echinoderms first figured in his valuable work on the 'Geology of Yorkshire.' To each of these kind friends I beg to tender my most grateful acknowledgments.

My best thanks are likewise especially due to Messrs. Bone and Baily, for the great care they have bestowed on the beautiful plates that enrich my Monograph, which, for scientific accuracy in details, and artistic effect in execution, are second to no lithographs of similar objects extant.

THOMAS WRIGHT.

EXETER PLACE, CHELTENHAM ;

August, 1856.

A MONOGRAPH
ON THE
FOSSIL ECHINODERMATA
OF THE
OOLITIC FORMATIONS.

SUB-KINGDOM—RADIATA.

THIS great division of the Animal Kingdom includes classes which differ widely from each other in form, organization, and habits. Some have the body circular, globular, or ringed; or vermiform, plant-like, or amorphous. Some are enclosed in a soft arachnoid, transparent membrane, and float like crystal masses through the water, as the *Infusoria* and *Acalephæ*; others hang like living stalactites from the roofs of submarine caverns, like the *Amorphozoa*; or, assuming the forms of the Vegetable World, they develop ramose stems, with numerous branches, of which myriads of zoophytes are at once the builders and inhabitants, as the *Polypifera*. Some are enclosed in exquisite shells, microscopic in size, but unrivalled in symmetry, although the structure that produces them is but a mere film of jelly, as the *Foraminifera*; others have a complicated calcareous skeleton, composed of many thousands of separate elements, which, for beauty and contrivance, is unsurpassed by that of any other class, as the *Echinodermata*. Where the nervous system has been discovered, it consists of a simple gangliated filament, surrounding the entrance to the digestive organs; but in by far the greater number of animals grouped in this division, no distinct nervous system is found, although the creatures themselves possess an exquisite sensibility.

The sub-kingdom RADIATA is formed of classes which are more remarkable for their

negative than for their positive characters: hence it wants that unity of composition so well displayed in the sub-kingdoms MOLLUSCA, ARTICULATA, and VERTEBRATA. Some naturalists have proposed to separate the RADIATA into two sections, under the names *Aneura* and *Cyclo-neura*, or *Acrita* and *Nemato-neura*; but, unfortunately, the nervous system of only a very few genera of the Cyclo-neura is known, so that, by generalizing too much upon these isolated facts, we are in danger of reasoning on an error in order to establish a method.

We include in the sub-kingdom RADIATA the six following classes, which may, for the sake of convenience, be subdivided into two sections;—in the one, the form of the body is more or less globular, sometimes it is symmetrical, often it is irregular or amorphous,—these form the GLOBULAR RADIATA. In the second section the body is stellate, and the divisions are arranged in the form of rays around a common centre,—this stellate form can often be shown to consist of a bilateral symmetry. These classes form the STELLATE RADIATA. The following table exhibits the sections and classes, to which are added the names of typical genera as examples of each:

| Sub-Kingdom. | Sections. | Classes. | Examples of Genera. |
|--------------|------------------|------------------|--|
| RADIATA. | Globular Radiata | 1. AMORPHOZOA | <i>Halichondria, Spongilla, Spongia.</i> |
| | | 2. FORAMINIFERA | <i>Orbitoides, Nummulites, Rotalia.</i> |
| | | 3. INFUSORIA | <i>Plæsconia, Dileptus, Paramecium.</i> |
| | Stellate Radiata | 4. POLYPIFERA | <i>Alcyonium, Oculina, Meandrina.</i> |
| | | 5. ACALEPHÆ | <i>Medusa, Physalus, Cassiopæia.</i> |
| | | 6. ECHINODERMATA | <i>Encrinus, Asterias, Echinus.</i> |

CLASS—ECHINODERMATA.

The name ECHINODERMATA was given by J. T. Klein, in 1734,* to the shells of Sea-urchins, which were called Echini. Bruguière† subsequently called that class which comprised the Star-fishes, and the Sea-urchins, ECHINODERMATA. Cuvier‡ included in his class ECHINODERMES, with *Asterias* and *Echinus*, the *Holothuria*, animals that are destitute of the prickly skin, of the more typical forms, and have many external affinities with some Mollusca; and subsequently, in his ‘Règne Animal,’§ he grouped in this class, *les Echinodermes sans pieds*, forming the order Sipunculoidea, which connect the Radiata with the Annelidous Articulata.

* ‘Naturalis Dispositio Echinodermatum,’ Jacobi Theodori Klein, 1734.

† ‘Tableau Encyclopédique des trois Règnes de la Nature,’ 1791.

‡ ‘Tableau Élémentaire de l’Histoire naturelle des Animaux,’ 1798.

§ ‘Règne Animal distribué d’après son Organisation,’ 1834.

The Echinoderms are most highly organized animals, and for the most part are covered with a coriaceous integument. In several orders it is strengthened with numerous calcareous pieces, which together form a complicated skeleton. The external surface of the skin, in many families, develops spines of various forms and dimensions, which aid in locomotion, and serve as defensive instruments to the creatures possessing them. By far the largest number of these animals have a complicated system of vessels for the circulation of water through their bodies. These aquiferous canals are intimately connected with the locomotion of the animal; for by means of it, most of the typical groups put in motion those remarkable suckers which protrude in rows from different divisions of the body. In the *Echinoidea* they escape through the holes in the poriferous zones, and in the *Asteroidea* they pass through apertures in the intervals of the small plates which form the middle of the rays, whilst in the *Sipunculoidea* these organs are altogether absent.

No class of the Animal Kingdom more clearly exhibits a gradation of structure than the *Echinodermata*; for, whilst some remain rooted to the sea bottom, and in this sessile condition and other points of structure resemble the *Polypifera*, others exhibit the true rayed forms, clothed in prickly armour, which characterise the central groups of this class. These conduct us, through a series of beautiful gradations, to soft elongated organisms, whose forms mimic the *Ascidian Mollusca*; whilst others have the long cylindrical body and annulose condition of the skin, with the reptatory habits of the *Apodous Annelida*.

With so fertile a field for investigation, it is not surprising that the minute anatomy of the Echinodermata should have engaged the attention of some of the most distinguished Naturalists of our age—Tiedemann, Müller, Van Beneden, Agassiz, Desor, Forbes, and Sharpey,—and have yielded fruits which the physiologist reckons as among the most marvellous contributions to morphological science.

The class Echinodermata is divided into eight orders, which, in descending sequence, may be thus arranged:

| | |
|-------------------|-----------------|
| 1. SIPUNCULOIDEA. | 5. OPHIUROIDEA. |
| 2. HOLOTHUROIDEA. | 6. BLASTOIDEA. |
| 3. ECHINOIDEA. | 7. CYSTOIDEA. |
| 4. ASTEROIDEA. | 8. CRINOIDEA. |

Order I. SIPUNCULOIDEA—form the apodal Annelidous Echinoderms; they have a long cylindrical body, divided into rings by transverse folds of the integument: they have no tubular suckers, nor calcareous parts in their body, nor is it divided into a quinary arrangement of longitudinal lobes: some have horny bristles, like the feet of many Annelida, which they somewhat resemble: their mouth is sometimes surrounded by tentacula, which are not, however, regulated by a definite number, nor disposed with the same regularity as in the next Order. They are unknown in a fossil state.

Type. *Sipunculus edulis*. Cuv. Pallas.

Order II. HOLOTHUROIDEA.—Body in general elongated; skin usually soft and leathery, in a few genera strengthened by calcareous or horny spines. Five avenues of suckers, which divide the body into as many longitudinal, nearly equal, lobes or segments; mouth surrounded by plumose tentacula, the numbers of which are in general multiples of five; anus at the opposite extremity of the body; digestive organs consist of a long intestine, which makes some coils in passing through the body; respiration performed by internal ramified tubes, like a miniature tree; locomotion effected by contractions and extensions of the body, and by rows of tubular suckers, similar to those in the Star-fishes and Sea-urchins. The softness of their naked integument prevents their preservation in the stratified rocks. We know none in a fossil state.

Type. *Cucumaria frondosa*. Grüner.

Order III. ECHINOIDEA.—Body spheroidal, oval, or depressed, without arms; furnished with a distinct mouth, sometimes armed, which is always below, and an anus which occupies different positions. Body enclosed in a shell or test, composed of twenty columns of calcareous plates, and ten rows of holes for the passage of retractile tubular suckers; the surface of the test is studded with tubercles, which possess, jointed with them, moveable spines, of various sizes and forms in the different families and genera: at the summit of the test is the apical disc, composed of five genital plates, perforated for the passage of the ovarial and seminal tubes, and five ocular plates for lodging the five eyes. The intestine winds round the shell, attached by a mesentery, the surface of which, as well as the membrane lining of the test, is covered with vibratile cilia.

Type. The common Sea-urchin, *Echinus sphæra*. Müller.

The ECHINOIDEA are represented by one family in the Palæozoic rocks, and by numerous families in the Mesozoic and Tertiary rocks, several of which characterise these great periods of geological time. They likewise abound in our present seas.

Order IV. ASTEROIDEA.—Body stelliform, depressed, provided with five or more lobes or hollow arms, which are a continuation of the body, and contain prolongations of the viscera; the mouth, which is always below and central, serves likewise as an anus; rows of retractile tubular suckers occupy the centre of the rays. Skeleton complicated, composed of numerous solid calcareous pieces, variable as to number, size, and disposition; skin coriaceous, studded with calcareous spines of various forms; a madreporiform plate on the upper surface, near the angle between two rays; eyes placed at the extremity of the rays; reptation performed by the tubular suckers.

Type. The common Star-fish, *Uraster rubens*. Linnæus.

This order is represented in the Silurian rocks by two genera. The Oolitic, Cretaceous, and Tertiary rocks contain many extinct forms. The existing species are very abundant in all the present seas.

Order v. OPHIUROIDEA.—Body discoidal, distinct, depressed, provided with long, slender arms, in which there is no excavation for any prolongation of the viscera; they are special organs of locomotion, and independent of the visceral cavity; they have spines developed from their sides; the mouth, surrounded by membranous tentacula, is always below and central, and serves at the same time as the anus. Skeleton complicated, composed of calcareous pieces, of which the size and number vary in different genera. The arms, long and slender, are sustained internally by central vertebral-like pieces, but they are not hollow or grooved underneath, as in the *Asteroidea*: they are special organs of locomotion, independent of, and superadded to, the visceral cavity, and have numerous plates or spines regularly disposed along their sides to assist in reptation.

Type. The common Sand-star, *Ophiura texturata*. Lamarck.

This order is represented by one genus in the Silurian rocks. Several genera are found in the Oolitic, Cretaceous, and Tertiary rocks, as well as in our present seas.

Order vi. BLASTOIDEA.—Body in the form of an oval calyx, composed of solid, calcareous plates, provided with five interambulacra and five ambulacra, the latter united superiorly, striated transversely, and having a deep furrow down the middle; ten ovarian holes, opening into five at the summit, and a central mouth aperture; a short, slender stem; but the body is destitute of arms.

Type. *Pentremites inflatus*. Sowerby. Carboniferous Limestone.

The genera are all extinct, and belong to the Palæozoic rocks. One species appertains to the Upper Silurian, six to the Devonian, and twenty-four are special to the Carboniferous rocks.

Order vii. CYSTOIDEA.—Body more or less spherical, supported on a jointed stem; the bursiform calyx is formed of close-fitting polygonal plates, varying in number in the different genera, and investing the surface like a coat of mail, except above, where there are three openings, one for the mouth, one for the anus, and one with a valve for the reproductive organs; the fourth aperture is below, and is continuous with the canal in the stem. Some have two or four arms, others are armless; certain species possess articulated tentacula, and curious comb-like appendages, or pectinated rhombs, in connection with the plates.

Type. *Pseudocrinites quadrifasciatus*. Pearce. Upper Silurian.

This order is extinct. All the genera are found in the Silurian and Devonian rocks.

Order viii. CRINOIDEA.—Body bursiform, distinct, formed of a calyx composed of a definite number of plates, provided with five solid arms, which are independent of the visceral cavity, and are adapted for prehension; a mouth and anus distinct; no retractile suckers; ovaries at the base of the arms opening into special apertures. Skeleton compli-

cated, calcareous, composed of thick plates closely articulated together, the number and arrangement of which are determinate in the different families, the multiples of five being the numbers which predominate; the central plate of the body is supported on a long, jointed column, which is firmly rooted to the sea-bottom. The mouth is central and prominent; the anus is situated at its side; the arms are mostly ramose and multi-articulate, and when extended form a net-like instrument of considerable dimensions. The mouth is always placed upwards, and retained in that position by the column being jointed to the central plate of the calyx. The normal station of the CRINOIDEA is the reverse, therefore, of the ASTEROIDEA and ECHINOIDEA.

Type. *Pentacrinus Caput-medusæ*. Miller. From the seas of the Antilles.

Extinct families of Crinoids have existed in all seas from the Silurian downwards, and one or two representatives are now living.

From the above analysis of the class ECHINODERMATA, it appears that, as the *Sipunculoidea* and *Holothuroidea* are not found in a fossil state, and the *Blastoidea* and *Cystoidea* are special to the Palæozoic period, our field of investigation in this Monograph is limited to the ECHINOIDEA, ASTEROIDEA, OPHIUROIDEA, and CRINOIDEA, which we now propose to consider seriatim, commencing with the ECHINOIDEA.

Order—ECHINOIDEA.

The body is spheroidal, oval, depressed or discoidal, and is enclosed in a calcareous test or shell, composed of ten columns of large plates, *the inter-ambulacral areas*: and ten columns of small plates, *the ambulacral areas*, which are separated from each other by ten rows of holes, constituting *the poriferous zones*. The external surface of the plates is studded with tubercles of different sizes, in the different families; these are articulated with the spines by a kind of moveable ball-and-socket joint: the spines are of various forms and dimensions, and serve well to characterise the genera and species.

At the summit of the test is the apical disc, composed of five genital plates, perforated for the passage of the ovarial and seminal canals, and five ocular plates, notched or perforated for lodging the eyes. There are two great apertures in the test, one for the mouth, and the other for the anus; the relative position of these oral and anal apertures varies in the different families, and forms an important character for their systematic classification.

The mouth is sometimes armed with a complicated apparatus of jaws and teeth, but sometimes it is edentulous. The internal organs of digestion consist of a pharynx, œsophagus, stomach, and intestine, which winds round the interior of the shell, attached thereto by a delicate mesentery, its surface, as well as that forming the lining membrane of the shell, is covered with vibratile cilia, the play of which causes currents of sea-water to traverse

incessantly the interior of the body, and to perform an important part in the function of respiration; their blood is circulated in arteries and veins, aided by a central pulsating organ or heart. The five ovaries and testicles occupy the ambulacral divisions, and open externally through the holes in the genital plates. Their locomotion is effected by the joint action of the tubular retractile suckers and the spines. Many sea-urchins attach themselves to rocks by these tubular feet, and some bury themselves in limestone, and sandstone or even in granitic rocks, by the abrading action of the spines.*

The nervous system consists, according to M. Van Beneden, of a circular cord, which surrounds the entrance to the digestive organs, and sends branches into the divisions of the body. Professor Agassiz, and the late Professor Edward Forbes, regarded the organs situated in the ocular plates as eyes, but M. Dujardin† denies them even a nervous system. In the absence of a greater amount of direct anatomical evidence on the point, the following observation, related by M. Alcide d'Orbigny,‡ has an important bearing on the question, and supports it affirmatively.

Captain Ferdinand de Candé, who commanded the 'Cléopâtre' in the Chinese seas, told M. d'Orbigny that he had captured, on their coasts, an urchin with long spines, probably a *Diadema*, which he examined in a vessel of water. "I hastened to seize it," he observed, "when it instantly turned all its spines in the direction of my hand, as if to defend itself.

"Surprised at this manœuvre, I made an attempt to seize it on the other side, when immediately the spines were directed towards me.

"I thought from this that the urchin saw me, and that the motion of the spines was intended as an act of self-defence; but, to prove whether this movement of the animal

* M. Eugène Robert exhibited to the Academy a block of old red sandstone, obtained from the shore of the great Bay of Douarnenez, which was perforated with numerous holes, evidently formed by the Echini which were lodged in them. Each rounded cavity is in exact proportion, both as to size and form, with the body of the Echinoderm. M. Lory, Professor at Grenoble, and well known for his numerous and excellent works on geology, has begged me to exhibit several specimens of perforating Echini, which have taken up their abode in the granite of the Bay of Croisic, not far from Piriac. It is the same granite as that from the Pouliguen, and in the same state of alteration. This igneous rock is there perforated by Mollusca and Echinodermata for an extent of several kilometers. Those which M. Lory has just discovered are certainly of the same species as the Echini which burrow in the old red sandstone of the Bay of Douarnenez. They closely resemble the Mediterranean *Echinus*, mentioned by Lamarck under the name of *Echinus lividus*. It is one of the most abundant Echini on the coast, and in the market of Marseilles, whence Lamarck obtained his specimens. I have never heard that these individuals possessed perforating habits; and probably a careful examination of living specimens of the *Echinus* from the coast of Brittany may show that it belongs to a distinct species, notwithstanding its apparent identity with that of the Mediterranean. In this case it might be called *Echinus terebrans*. 'Observations on Echini perforating the Granite of Brittany,' by M. Valenciennes.—*Comptes Rendus*, Nov. 5, 1855, p. 755.

† Lamarck, 'Animaux sans Vertèbres,' 2d ed., tom. iii, p. 200.

‡ 'Paléontologie Française Terrains Cretacés,' tom. vi, p. 12.

was produced by my approach, or merely by the agitation of the water, I repeated the experiment very slowly, and even over the water with a stick: the urchin, whether in the water or out of it, having always directed its defensive spines towards the object which approached it. From these observations I arrived at the conclusion that these urchins see, and that their spines serve them as defensive instruments."

It is worthy of remark, that Captain Candé, at the time he watched this urchin, was ignorant of the anatomical fact that eyes had been detected in the Echinidæ, and his inference was simply the legitimate conclusion drawn from carefully-made observations.

The calcareous test of the Echinoidea is the only part of the structure of these animals which is preserved in a fossil state. It has hitherto failed to attract that amount of attention from the palæontologist which the importance of its study demands, although in a stratigraphical point of view it is not inferior to the skeletons of any other class of the Animal Kingdom. The fact seems to have been almost entirely overlooked, that most of the generic characters of the different groups of the Echinoidea are more indelibly impressed on the separate pieces of their test than in the skeletons of any other class of the Invertebrata.

Unlike the shells of the Mollusca, the test of the Echinoidea constitutes an internal and integral portion of the animal, being secreted by, and enclosed within, organized membranes, and participating in the life of the organism; portions of the skeleton are likewise intimately connected with the organs of digestion, respiration, and generation, as well as with those of vision and locomotion.

As the analysis of the test of the Echinoidea, with full anatomical details of the structure of the skeleton in the Echinodermata in general, will be given in the Introduction to this Monograph, it is unnecessary to enter at present minutely into the subject; but, as many of our readers are doubtless unacquainted with the terminology employed in the description of the test of the Echinoidea, and the characters on which a diagnosis of the species is made, it is desirable now to preface our description of the species with brief explanations of the same, in this part of the work, illustrating the terminology by a reference to the plates for accurate figures of the different parts of the test, and the magnified details of its anatomical characters.

Terminology, or descriptive analysis of the component elements of the test of the Echinoidea.

The test of the Echinoidea is composed of the following parts :

- a.* Five ambulacral areas.
- b.* Five inter-ambulacral areas.
- c.* Ten poriferous zones.
- d.* An anal opening, and anal membrane and plates.
- e.* A mouth opening, and buccal membrane and plates.
- f.* Five jaws when organs of mastication exist; some are edentulous.
- g.* Tubercles of various sizes, developed on the outer surface of the plates.
- h.* Spines of various forms and dimensions, which are jointed with the tubercles.

These are the parts essential to be known; but there are others of secondary importance, which will be described hereafter in their proper place.

The Body of the Echinoidea is divisible into three parts :

1st. The calcareous envelope or skeleton has a globular, circular, oval, pentagonal, hemispherical, conoidal, or discoidal form; it is composed of a framework of pentagonal, hexagonal, and polygonal calcareous plates. This testaceous box is called the test. It is the *form*, the *test* of Agassiz; the *general form*, the *test* of Desmoulins; *la coquille* of d'Orbigny.

2d. The visceral cavity, which contains the organs of digestion, respiration, circulation, and generation, is formed entirely by the calcareous skeleton.

3d. The external surface of the test is covered with spines, which are moveably articulated with the tubercles developed on the surface.

The normal position of the body.—In describing the different parts of the test of the Echinoidea, it is assumed that the urchin, the common purple-heart urchin, *Spatangus purpureus*, Müller, for example, is placed before the observer; or, the common chalk urchin, *Micraster cor-anguinum*, Klein, will answer equally well. The side with the single ambulacrum lodged in the sulcus, and the mouth in that third of the base, is the *anterior region*. The four other ambulacra are disposed in pairs, and correspond to the right and left sides of the observer's body; there is, therefore, a right antero-lateral and a right postero-lateral; a left antero-lateral and left postero-lateral ambulacral area. The side having the single inter-ambulacrum in the middle, and the anal opening in the upper part of the border, is the *posterior region*. The four other inter-ambulacra are likewise disposed in pairs, two of which, with the single ambulacrum, form the anterior part of the test; the other pair, with the pairs of ambulacra, forming the sides, and the single inter-ambulacrum its posterior part.

All the Echinoidea have the mouth situated at the under side of the body. The surface in which this opening is placed is called the *base*; that region of the test opposite to the base is the *upper* or *dorsal surface*.

The most convex part of the margin, border, or sides, between the base and the upper surface, is called the *circumference*,—the *ambitus* of some authors. It is round, flat, convex, angular, or carinated, according to the general form and thickness of the test.

The *length*, or *antero-posterior* diameter, is the distance between the anterior and posterior regions, and corresponds to the middle line of the body.

The *breadth*, or *transverse diameter*, is the distance between the greatest lateral convexity of the circumference, in the direction of a line which will cut the line of length at right angles.

The *height* is the distance between the most convex part of the upper surface and a plane on which the base of the test can rest. The apical disc is generally situated at the vertex, but it is not always so. The height has reference to the highest point of the test, quite irrespective of any other consideration.

The test has invariably two openings, the one for the mouth, the other for the anus.

The *mouth-opening* is always situated at the under surface; to its circumference is attached the buccal membrane, and through its central aperture, when they exist, protrude the five jaws. (Pl. IV, fig. 1 *b*; Pl. XI, fig. 1.) The buccal, like the anal membrane in many families, is clothed with numerous small plates. In *Cidaris*, *Rabdocrinis*, *Goniocrinis*, *Diplocarinis*, and probably in other *Cidaridæ*, the mouth-opening is central, circular, or slightly pentagonal (Pl. I, figs. 2 *a*, 4 *a*; Pl. II, figs. 1 *a*, 2 *b*); but in *Hemicarinis*, *Diadema*, *Hemipodina*, *Podina*, *Echinus*, and other ECHINIDÆ, the mouth opening is more or less decagonal, its margin being divided by notches (*entailles*) into ten lobes. (Pl. III, figs. 2 *b*, 6 *b*; Pl. IV, fig. 2 *b, e*; Pl. V, fig. 1 *e*; Pl. VI, figs. 2 *b*, 5 *c*.) The lobes are, in general, unequal in size; those which correspond to the base of the ambulacra are the largest, and are called the *ambulacral lobes*; those corresponding to the base of the inter-ambulacra are the *inter-ambulacral lobes*. The margin of the mouth-opening is called the *peristome*; to it the buccal membrane, which closes the base of the test, is attached.

The *mouth-opening* is central, and is armed with jaws, in the Cidaridæ, Echinidæ, Salenidæ, Galeritidæ, and Clypeasteridæ. It is more or less excentral and edentulous in the Echinonidæ, Collyritidæ, Echinolampidæ, Echinocorydæ, and Spatangidæ. In these families it is round, oval, or pentagonal; sometimes its margin is ray-like, or surrounded by five prominent lobes; in others it is distinctly bilabiate.

The *anal opening* is always in the upper surface, directly opposite to the mouth, in the centre of the genital and ocular plates, and is either central or sub-central in the Cidaridæ, Echinidæ, and Salenidæ. (Pl. III, figs. 1 *e*, 3 *c*; Pl. IV, figs. 1 *g*, 2 *f*.) In the other families its position varies much; sometimes it opens on the upper surface, as in some Galeritidæ and Cassidulidæ; sometimes it opens near the margin, or is *supra-marginal*, marginal, or *infra-marginal*; often it opens at the base, between the mouth and

the border. During the life of the animal this opening was closed by an anal membrane, and a series of small angular anal plates, the number and disposition of which vary in the different genera. The anal plates are seldom preserved in fossil species; and the term anal opening is given to all that part of the test occupied by them, the anal membrane, and the vent.

The Ambulacral and Inter-ambulacral Areas.

The test is composed—1st, of twenty columns of calcareous plates of different sizes, the *plaquettes*, *Tüfelchen*, *Assulæ*, of authors. They are pentagonal in form, and are united by harmonial sutures to form rays, which proceed from the mouth, where they have their greatest breadth, to the apical disc, where they are narrowest. 2d, of a series of hexagonal or polygonal plates, forming a disc, which occupies the upper surface of the test. 3d, of ten rows of small plates, which are notched on their margins, to form holes: these constitute the poriferous zones. 4th, of moveable spines, which are jointed with eminences on the outer surface of the columnar plates.

The *ambulacral plates* form two narrow columns, which are bounded by two poriferous zones. The space thus circumscribed is the *ambulacral area*. There are five of these areas in the test of the Echinoidea; in the Cidaridæ the ambulacral areas are very narrow, and support only granules (Pl. II, fig. 1 *a, b*); but in the Echinidæ (Pl. VIII, fig. 1) they are much wider, and have large tubercles on their surface. The comparative width of the ambulacra, as compared with the inter-ambulacra, has led some authors* to divide the family Cidaridæ, including therein the Echinidæ, into two tribes,—the ANGUSTISTELLÆ, or Cidaridæ with narrow ambulacra, and the LATISTELLÆ, or Cidaridæ with broad ambulacra. These two tribes nearly represent our two families: the Cidaridæ are equal to the ANGUSTISTELLÆ, and the Echinidæ are nearly equal to the LATISTELLÆ.

Pl. I, figs. 1 *b*, 2 *c*, 3 *c*, 4 *c*; Pl. II, figs. 1 *c*, 2 *g* represent the structure of the ambulacra in the Cidaridæ; and Pl. VI, fig. 2 *d*, and Pl. VII, figs. 3 and 4, show the structure of the ambulacral areas in some Echinidæ.

One of the ambulacral areas is single, and always represents the anterior region of the test. In the spheroidal Echinidæ and Salenidæ, this is detected by its relation to the apical disc, as the right antero-lateral genital plate always carries the madreporiform body; but in the oval, pentagonal, and elongated forms, its position and relation to the mouth render it unmistakeable. The four other ambulacra are disposed in pairs.

The *inter-ambulacral plates* form two broad columns, which compose the inter-ambulacral areas. Of these there are five, which alternate with the ambulacral areas in the architecture of the test: the poriferous zones form the line of demarcation between these

* Albin Gras, 'Description des Oursins Fossiles de département de l'Isère,' p. 20.
E. Desor, 'Synopsis des Echinides Fossiles,' p. 1.

two classes of columnar plates. The inter-ambulacral plates are all pentagonal, and many times larger than the ambulacral; they carry on their external surface the large primary tubercles. Of the five inter-ambulacral areas, one is single and posterior; and in all the Echinoidea which have the anal opening external to the apical disc, it is in this single inter-ambulacrum that the vent terminates. The other four inter-ambulacra are disposed in pairs, and form the greater part of the anterior and lateral parts of the test. They are called *anterior pairs* and *posterior pairs* respectively, to distinguish them from the odd area, which is called the *single inter-ambulacrum*.

Pl. I, figs. 1 *b*, 4 *e*; Pl. II, fig. 1 *a, b, c*, show the form and structure of the inter-ambulacra in the *Cidaridæ*; and Pl. VI, fig. 2 *a, b*; Pl. VIII, fig. 1 *a, b*, the structure of these areas in the *Echinidæ*.

In the *Cidaridæ*, and in some *Echinidæ*, the inter-ambulacral areas have only two rows of primary tubercles; but in most of the *Echinidæ* there are four, six, eight, or even ten rows of primary tubercles in these areas.

The Poriferous Zones.

The *poriferous zones* are situated on each side of the ambulacral areas. (Pl. I, fig. 4 *a*; Pl. II, figs. 1 *a, b*, 2 *b, c*.) They are composed of a very great number of small pieces, articulated together in such a manner as to form a series of holes, the corresponding edges of the plates, remaining uncalcified at certain definite intervals, to produce foramina, which are destined for the passage of retractile tubular suckers. The form and structure of the poriferous zones afford a good generic character. As there are two poriferous zones bordering each ambulacral area, it follows that there are ten zones. Some authors give the collective name *ambulacra* to the *zones* and the *area*, but, for obvious reasons, we consider them distinct sections of the test, and treat of them as such. The pores are *round*, *oblong*, or *elongated*; the pores forming a pair may be *equal* or *unequal*, or, in relation to each other, they may be *transverse* or *oblique*; they may be *contiguous* or *remote*, and when they are united by a transverse sulcus, they are said to be *conjugate*.

The pores are differently arranged in the zones in the different families. When they are disposed in single pairs they are said to be *unigeminal* (Pl. II, fig. 1 *c*); when in double pairs they are *bigeminal* (Pl. VI, fig. 3 *c, d*); when in triple oblique pairs they are *trigeminal* (Pl. VI, fig. 2 *g*; Pl. XII; Pl. XIV; Pl. XV), or when they are grouped in a greater number, as in many living species of the genus *Echinus*, they are *polygeminal*.

When the zones extend in a straight uninterrupted line from the mouth to the apical disc, they are said to be *simple*, as in the *Cidaridæ*, *Echinidæ*, *Salenidæ*, *Galeritidæ*, *Echinonidæ*; when the zones, after parting from the apical disc, expand, and again contract, thereby forming a leaf-like figure on the upper surface of the test, they are said to be *petaloidal*, as in the *Clypeasteridæ*; when the petal is not so complete as in the *Cassidulidæ*, it is *sub-petaloidal*. The zones are *complete* when they extend without inter-

ruption from the mouth to the disc; they are *interrupted* when they terminate on the upper surface, and reappear again at the base near the mouth; they are *limited* when they form only a star on the dorsal surface. These terms all represent generic and specific characters of greater or less value, which require to be carefully noted in the description of the species.

The Apical or Genital Disc.

The *apical disc* occupies in general the centre of the summit of the test, and is composed, in most of the genera, of ten plates,—namely, five genital plates, and five ocular plates. (Pl. III, figs. 1 *e*, 2 *f*, and Pl. IV, fig. 2 *f*.) In the *Salenidæ* there is one or more additional plates introduced. The *five genital* or *oviductal plates* correspond to the summits of the inter-ambulacral areas (Pl. III, figs. 1 *a*, 3 *a*); two plates form an antero-lateral pair, two a postero-lateral pair, and the single plate is placed behind. On the right antero-lateral genital plate (Pl. IV, figs. 1 *g*, 2 *f*) is placed a spongy prominent mass, called the *madreporiform body*. The plate, supporting this body, was supposed by Agassiz and Desor always to represent the posterior part of the test, but we shall show in the sequel it is invariably placed on the right antero-lateral plate.

The *ocular plates* are placed at the summit of the ambulacral areas. They are small heart-shaped bodies (Pl. IV, fig. 1 *g*), and are wedged into the angles of the genital plates around the circumference of the disc.

The *sur-anal plates* are found only in the *Salenidæ*. They consist of one or many elements placed in the centre of the genital circle, and almost always before the anal opening. (Pl. XVI.)

The *anal plates* are very small bodies, and are variable as to size and number; they clothe the membrane of the anal opening, and are well seen in recent urchins, but are seldom preserved in fossil species.

The Tubercles.

The plates which compose the test of the *Cidaridæ*, *Echinidæ*, and *Salenidæ*, have large tubercles developed on their external surface. They are divided into *primary tubercles*, *semi-tubercles*, *secondary tubercles*, *minute tubercles*, *granules*, and *miliary granulation*. In the other families the tubercles are smaller, more numerous, and less complicated.

The *primary tubercles* form two rows in the inter-ambulacral areas of the *Cidaridæ* (Pls. I and II), and in the genus *Hemicidaris* (Pls. III and IV), and a section of the genus *Diadema* (Pls. VI and VII); and four, six, eight, or ten rows in many *Echinidæ*.

The *semi-tubercles* are found at the base of the ambulacral areas of the genus *Hemicidaris*. (Pl. III, fig. 1 *b*, *c*; Pl. IV, fig. 1 *c*, *d*.) In a section of the genus *Hemipedia*, they likewise are found at the base of the ambulacra (Pl. XI, fig. 2).

The *secondary tubercles* are found in many of the *Echinidæ*, ranged in general on the ambulacral side in the primary tubercles. They are found likewise on the centro-sutural side of the primary rows (Pl. VII, fig. 4, and Pl. VIII, fig. 1) of many *Diadema*, *Pedina*, *Hemipedina*, and *Echinus*.

The *minute tubercles* are the small tubercles which are found on the margins of the ambulacral areas in the genera *Cidaris* and *Hemicidaris*. (Pl. III, fig. 1 *b, c*; Pl. IV, fig. 1 *d*.) They sometimes fill up spaces at the base of the inter-ambulacral areas, as in some *Diademas*; (Pl. VI, fig. 2 *g*) they are always raised on little eminences, and are in general perforated like the secondary and primary tubercles. In this respect they are distinguished from the granules.

The *granules* are small, round, hemispherical elevations, scattered more or less regularly, and distributed over different parts of the plates of the test. In some species of the genus *Cidaris*, they are arranged in rows in the centre of the ambulacral areas (Pl. I, fig. 4 *e*; Pl. II, figs. 1 *c*, 2 *g*; Pl. III, fig. 2 *d*); or they form circles around the circumference of the areolas of the primary tubercles. (Pl. II, fig. 2 *g*.)

The *miliary granulation* is formed by a number of small granules closely set together in the centre of the ambulacra (Pl. III, fig. 6 *a*; Pl. V, fig. 2 *d*), or on the inter-tubercular surface of the large plates forming the inter-ambulacra. (Pl. II, fig. 1 *b, c*; Pl. VI, fig. 2 *c, d*.)

The primary tubercles of the genera *Cidaris*, *Hemicidaris*, *Diadema*, *Hemipedina*, *Pedina*, &c., consist of the following parts:

The *hemispherical tubercle* or *mamelon*, which is sometimes perforated in the centre, as in all the *Cidaridæ* (Pl. II, fig. 1 *c, d*): sometimes it is imperforate, as in many *Echinidæ* (Pl. XVI).

The *boss* or *mamillary eminence* is the conical prominence which rises from the surface of the tubercular plate (Pl. II, fig. 1 *d*); its summit supports the tubercle; its margin is sometimes crenulated in *Cidaris*, *Hemicidaris*, and *Diadema*, and sometimes smooth in *Hemipedina* and *Pedina*. These characters are important for generic distinctions.

The *areola* or *scrobicule* (Pl. II, fig. 1 *c*) is the round, oval, or elliptical, smooth, excavated space which surrounds the base of the boss. This space is sometimes wide (Pl. II, fig. 1 *c*), sometimes narrow (Pl. IV, fig. 1 *d*); sometimes its margin is elevated into a ridge which encircles it completely (Pl. II, fig. 2 *g*); the *scrobicular* or *areolar circle* is then said to be complete; sometimes the upper and under sides of the circle are wanting, when it is *incomplete*, and the areolas in this case are said to be *confluent*. (Pl. I, fig. 1 *b*; Pl. IV, figs. 1 *d*, 2 *c*.)

The row of granules, which encircles the areola, is called the *areolar* or *scrobicular circle*.

The *miliary zone* is the space comprised between the two ranges of primary tubercles. This zone is sometimes destitute of miliary granules, when it is said to be naked; sometimes it is covered with a close-set granulation. We have, therefore, the ambulacral miliary

zone, and the inter-ambulacral miliary zone, when they occupy these different regions of the shell.

When the granules are microscopic, and are closely clustered together to form certain narrow, circumscribed bands or *fascioles* which intersect the general tubercular surface, and occupy fixed positions on the test, the microscopic granules composing these zones are called *fasciolar*.

Fascioles are only found in two families, in one genus of the *Echinocorydæ*, and in almost all the genera of the *Spatangidæ*. The form, width, structure, and position of these bands must be carefully noted, as they afford important characters, both positive and negative, which serve in the diagnosis of the genera.

When the fasciole surrounds the circumference of all the petaloidal portions of the ambulacral areas, it is called *peripetalous*; when it encircles the single ambulacrum alone, it is *internal*; when it extends along the flanks, it is *lateral*; when it passes in whole or in part along the circumference, it is *marginal*: and when it surrounds the base of the single inter-ambulacrum, it is *sub-anal*: sometimes there is only *one*, sometimes there are *two* or *three*, of these fascioles in different genera.

Each family has a special arrangement of the tubercles, granules, and fascioles, which will require a detailed notice in the general outline of the structural characters prefixed to the description of each natural group.

The *sutural impressions* are the lines along which the plates are united together. Sometimes they are mere lines (Pl. I, fig. 4 *b*; Pl. II, figs. 1 *b*, 2 *c*); sometimes the impressions amount to excavations out of the borders of the plates, and give rise to cavities therein, as in the genus *Temnopleurus*.

The *angular* or *sutural pores* are small impressions, situated in some genera at the angles of the plates, upon the median line of the miliary zones.

The external appendages of the Test.

The *spines*, or *Radioli* as they were called by Plott, Langius, and other old authors, are the calcareous appendages which are moveably articulated with the tubercles of the test. They present numerous modifications as to size, form, and sculpture, which are all intimately connected with specific characters. Some are short, elongated, flattened, cylindrical, fusiform, or subulate; others are compressed, spatuliform, or triangular; others, on the contrary, are expanded, pyriform, or claviform. The surface of the spines is smooth, or striated with fine or coarse longitudinal lines; some have verticellate processes at regular intervals; others have asperities, prickles, or granules, disposed with more or less regularity over the surface; the different parts of the spine have received the following names:

The *articular cavity*, or *acetabulum*, is the socket by which the spine articulates with

the tubercle. Its margin is smooth, or crenulated, according as the summit of the boss is smooth or crenulated. (Pl. II, fig. 2 *e*.) In all the genera in which the tubercles are perforated, there is a corresponding pit in the socket of the spine for the attachment of a round ligament, which passes from the tubercle to the spine.

The *head* is that part of the spine which contains the articulating cavity, and is united to the stem near the neck. (Pl. I, fig. 1 *f*; Pl. II, fig. 2 *e*.)

The *milled ring* surrounds the head. It is a prominent ridge, more or less deeply crenulated, around which the muscular fibres that move the spine are firmly attached. (Pl. I, fig. 5 *b*.)

The *neck of the spine* is the smooth space between the line of junction above the milled ring and the rugose body of the spine. (Pl. I, fig. 1 *f*.) It is often finely striated with longitudinal lines. In long slender, tapering spines, (Pl. IV, fig. 1 *o*,) the neck often cannot be distinguished from the body, into which it passes.

The *stem*, or *body of the spine*, is the part which exhibits the greatest variety of forms. Smooth and muricated varieties are figured in Plates I, II, IV.

The organs of mastication, forming the lantern of Aristotle, are rarely preserved in fossil species. They consist of five jaws, each carrying a long tooth. (Pl. IV, fig. 1 *b, f*.) As these parts form a complicated mechanism, their analyses and description will be given at length in the anatomical part of the Introduction.

In this descriptive terminology of the skeleton, we have limited our observations to the ECHINOIDEA, the iconography and description of the British Oolitic species of which forms the first part of this Monograph: it is our intention to preface the description of the ASTEROIDEA, OPHIUROIDEA, and CRINOIDEA, which follow seriatim, with similar analyses of the specialities of their organization.

On the relative value of the external organs in the classification of the Echinoidea.

The mouth is always basal, central, subcentral, or excentral, but the excentricity is invariably towards the anterior border. This opening does not, therefore, afford a character of primary importance, although, in connection with others, it is valuable in the definition of families. The mouth is sometimes armed with jaws, but sometimes it is edentulous.

The position of the anal opening affords a character of primary importance. In one great section the anus opens *within* the centre of the apical disc, surrounded by the genital and ocular plates. The relation, therefore, of the digestive organs to those of generation and vision, is an important primary character for the zoologist. In another section the anal opening is *without* the apical disc, and is more or less external to, and at a greater or less distance from, the genital and ocular plates. The physiological importance of the external

relation of the organs of digestion, generation, and vision, to each other, imparts great value to the position of the anal opening; and hence it forms the basis of the subdivision of this order into two sections, which are thus defined:

Echinoidea endocyclica.

- A. Test circular, spheroidal, more or less depressed, rarely oblong; mouth in the centre of the base. Anus in the centre of the upper surface, directly opposite to the mouth, surrounded by the five perforated genital plates, and having external to them the five ocular plates. Mouth always armed with five powerful calcareous jaws, formed of many elements, disposed in a vertical direction.

Echinoidea exocyclica.

- B. Test sometimes circular and hemispherical; oftener oblong, pentagonal, depressed, clypeiform or discoidal; mouth central or ex-central. Anus external to the circle of genital and ocular plates, never opposite the mouth, but situated in different positions in relation to that opening: four of the genital plates are generally perforated. The mouth is sometimes armed with five jaws, but it is oftener edentulous. The elements of the lantern are disposed in a more or less horizontal direction.

The structure of the ambulacral areas, and the poriferous zones, which are in relation with the organs of respiration and locomotion, afford good characters of secondary importance, for grouping the genera into natural families, especially when taken in connection with the position of the anal opening, which varies in its relation to that of the mouth opening in different families.

The form, number, and arrangement of the tubercles, and the spines which are jointed with them; the miliary granulation; the bands of microscopic granules forming the fascioles, which have determinate and permanent positions on the test; added to the size and number of the elements of the apical disc, and the position of the anus, afford collectively good characters for defining the genera.

The minute details in the structure of the plates; the form, and size, and number of the tubercles on each of them,—the form and arrangement of the pores in the zones; their proximity or remoteness from each other; the general outline of the test, which has only certain limits of variation; the character of the sculpture on the plates; the form of the areolas; the presence or absence, the size and distribution of the granules forming the areolar or scrobicular circle; the completeness or incompleteness of the same. The length of the spines, their form and sculpture, are all points which afford good specific characters, as they are persistent details which are developed on every considerable fragment of the test and spines of Echinoidea.

Taking these general principles for our guidance, we subdivide the Echinoidea into the following natural families :

| | | |
|-------------------|---|-----------------|
| Order—ECHINOIDEA. | <i>Echinoidea endocyclica.</i> | Cidaridæ. |
| | Anus within the genital plates, always opposite the mouth. | Hemicidaridæ. |
| | | Diademadæ. |
| | | Echinidæ. |
| | | Salenidæ. |
| | <i>Echinoidea exocyclica.</i> | Echinoconidæ. |
| | Anus without the genital plates, never opposite the mouth. | Collyritidæ. |
| | | Echinonidæ. |
| | | Echinobrissidæ. |
| | | Echinolampidæ. |
| | | Clypeasteridæ. |
| | | Echinocoridæ. |
| | | Spatangidæ. |

Family 1. CIDARIDÆ.—Test thick, spheroidal ; inter-ambulacral areas very wide ; primary tubercles large, perforated ; bosses crenulated or uncrenulated, spines large, thick, and mostly claviform ; ambulacral areas very narrow ; poriferous zones narrow, pores unigeminal, rarely bigeminal ; mouth opening large, inferior, central, circular or pentagonal ; peristome destitute of notches, always armed with large and powerful jaws. Anal opening wide, superior, opposite to the mouth, surrounded by five genital plates, perforated for the genital canals, and five ocular plates excavated for lodging the eyes ; buccal and anal membranes covered with scales.

Types. *Cidaris florigemma*, Phillips. *Cidaris Smithii*, Wright. (Pl. II.)

Family 2. HEMICIDARIDÆ.—Test thick, spheroidal, or more or less depressed ; ambulacral areas narrow or wide, with semi-tubercles at their base only, or extended throughout the area ; inter-ambulacral areas with two rows of primary tubercles, rarely more than eight in each row ; the tubercles of both areas are perforated, and the bosses are deeply crenulated ; the poriferous zones are narrow and undulated ; the pores are unigeminal throughout, except near the peristome, where they are bigeminal and trigeminal. The mouth opening is large ; the peristome is decagonal, and is divided by more or less deep notches into ten lobes ; the jaws are large and powerful ; the apical disc opposite the mouth is small, and is composed of five genital plates and five ocular plates. The spines are long, thick, cylindrical, tapering, or claviform, or stout, compressed, and angular ; their surface is smooth, or covered with fine longitudinal lines, but, as far as is known, neither prickles nor asperities are developed thereon.

Types. *Hemicidaris intermedia*, Fleming (Pl. IV). *Acrocidaris formosa*, Agassiz.

Family 3. DIADEMADÆ.—Test thin, circular, or pentagonal, more or less depressed ;

ambulacral areas wide, with two or four rows of primary tubercles ; inter-ambulacral areas with two, four, six, or more rows of tubercles, nearly of the same size and structure as those of the ambulacra ; the tubercles are perforated or imperforated, crenulated or uncrenulated, in different genera ; the apical disc opposite the mouth is small, and composed of five genital and five ocular plates ; the poriferous zones are narrow ; the pores are unigeminal or bigeminal. The mouth opening is large and decagonal ; the peristome is divided into ten lobes by deep notches ; the spines are long, cylindrical, more or less slender, and are either tubular or solid ; sometimes they are encircled by spiral verticillate processes, or their surface is sculptured with fine longitudinal lines.

Types. *Astropyga radiata*, Leske. *Diadema pseudo-diadema*, Lamarck (Pl. VIII, fig. 1). *Cyphosoma Königii*, Mantell. *Hemipedita Marchamensis*, Wright (Pl. XI, fig. 1).

Family 4. ECHINIDÆ.—Test thin, spheroidal ; inter-ambulacral areas, with primary tubercles, small and of various sizes, perforate or imperforate ; bosses crenulate or uncrenulate ; ambulacral areas wide, always supporting two or more rows of primary tubercles ; poriferous zones narrow or wide, pores unigeminal, trigeminal, or polygeminal, and disposed in arcs ; spines short, mostly subulate. Mouth opening large, inferior, always decagonal ; the peristome divided into lobes by notches more or less deep. Anal opening small, superior, opposite the mouth, surrounded by five genital and five ocular plates ; buccal membrane naked.

Types. *Arbacia Forbesii*, Wright (Pl. XIII). *Glypticus hieroglyphicus*, Münster (Pl. XIII). *Echinus bigranularis*, Lamarck (Pl. XIV).

Family 5. SALENIDÆ.—Test thin, spheroidal ; inter-ambulacral areas wide, with few primary tubercles, which are either perforate or imperforate, crenulate or uncrenulate ; ambulacral areas narrow, carrying secondary tubercles. Mouth opening small or large, inferior, decagonal ; peristome more or less notched. Anal opening superior, surrounded by the plates of a large apical disc, composed of more than ten pieces, and which occupies a wide aperture in the superior part of the test. Poriferous zones narrow, pores unigeminal, except near the peristome, where they are trigeminal. Spines long, subulate, circular, or flattened. Species all extinct ; the genera distributed in the Oolitic, Cretaceous, and Tertiary rocks.

Types. *Salenia petalifera*, DeFrance. *Acrosalenia hemiciidaroides*, Wright (Pl. XVI). *Goniophorus lunulatus*, Agassiz.

Family 6. ECHINOCONIDÆ.—Test thin, circular, elongated or pentagonal, elevated or depressed ; inter-ambulacral areas wide, ambulacral areas narrow ; the external surface of the plates of both covered with numerous small, perforated, and crenulated tubercles ; poriferous zones narrow, pores unigeminal, except near the base, where they are trigeminal. Mouth opening inferior, central, circular, or pentagonal, armed with five jaws ;

peristome notched, dividing the circumference into ten nearly equal lobes. Apical disc central, superior, composed of five genital and five ocular plates; the madreporiform body being large, and extending from the right antero-lateral genital plate into the centre of the disc. Anal opening situated at the upper surface, in the margin, or at the inferior surface of the test. Spines small, short, subulate. The species are all extinct; the genera are distributed in the Oolitic and Cretaceous rocks.

Types. *Echinoconus albo-galerus*, Klein. *Pygaster semi-sulcatus*, Phillips (Pl. XVII). *Holactypus depressus*, Leske.

Family 7. COLLYRITIDÆ.—Test thin, circular, or oval; ambulacral areas meeting at two points on the upper surface, which are more or less apart; poriferous zones narrow, pores unigeminal; tubercles small, numerous, perforated, and crenulated. Mouth opening ex-central, small, round, oval; peristome feebly fissured; jaws unknown. Anus round, oval, supra-marginal; elements of the apical disc detached; four genital holes. The species are all extinct, and distributed in the Oolitic and Cretaceous rocks.

Types. *Collyrites ringens*, Desmoulins. *Collyrites ovalis*, Parkinson.

Family 8. ECHINONIDÆ.—Test thin, oval; poriferous zones narrow, meeting at the apical disc; pores unigeminal; tubercles of both areas nearly equal, but neither perforated nor crenulated; spines stout, subulate. Mouth opening nearly central, irregularly pentagonal, and edentulous. Anal opening oblong or pyriform, basal or marginal, closed by anal plates; apical disc nearly central; four genital pores. One group is living in tropical seas; another is found fossil in the Cretaceous rocks.

Types. *Echinoneus cyclostomus*, Leske. *Pyrina Desmoulinsii*, D'Archiac.

Family 9. ECHINOBRISIDÆ.—Test thin, circular, oblong, sub-pentagonal or clypeiform, covered with small tubercles, surrounded by excavated areolas; ambulacra narrow, enclosed by poriferous zones, more or less petaloidal; pores set at different distances apart, and united by connecting sutures. Mouth opening small, nearly central, pentagonal, and edentulous, in general surrounded by five lobes. Anal opening, lodged in a sulcus, in the upper surface of the single inter-ambulacrum, or in a marginal depression thereof; apical disc small, four genital lobes; madreporiform body extending into the centre of the disc. One species is living, the others are all extinct, and distributed in the Oolitic, Cretaceous, and Tertiary rocks.

Types. *Echinobrissus clunicularis*, Llhwyd. *Clypeus sinuatus*, Leske. *Catopyrus carinatus*, Goldfuss. *Pygaulus cylindricus*, Desor.

Family 10. ECHINOLAMPIDÆ.—Test thin, oblong, oval, elevated or sub-discoidal; ambulacra large, petaloid; poriferous zones wide; pores placed apart, and united by a suture; the zones extend near to the margin. Mouth small, surrounded by five lobes,

sometimes it is transversely oblong. Anal opening transversely oblong, and infra-marginal; apical disc small, excentral, with four genital holes. Some species are living in warm seas, but the greatest number are extinct, and distributed in the Oolitic, Cretaceous, and Tertiary rocks.

Types. *Echinolampas orientalis*, Gray. *Pygurus depressus*, Agassiz. *Conoclypus Leskii*, Goldfuss.

Family 11. CLYPEASTERIDÆ.—Test thick, elevated or depressed, circular, elliptical, or pentagonal; the surface closely covered with small, nearly equal-sized tubercles, sunk in the plates, and surrounded by ring-like areolas, the tubercles carrying short hair-like spines. The mouth large, central and pentagonal, and armed with five strong jaws, which carry the same number of teeth. The anus posterior, marginal or infra-marginal; the interior of the test is sometimes divided by pillar-like processes formed of the inner layer of the plates. The dorsal portions of the ambulacral areas have a petaloid form, circumscribed by large poriferous zones; the basal portions are narrow, rectilineal, or branched; the five genital plates form a circle around the madreporiform body, and between these are wedged the five ocular plates. This family includes the genera *Clypeaster*, Lamk., *Laganum*, Klein., *Echinarachnius*, Van Phels., *Arachnoides*, Klein., *Scutella*, Lamk., *Dendraster*, Agass., *Lobophora*, Agass., *Encope*, Agass., *Echinodiscus*, Breynius, *Mellita*, Klein., *Runa*, Agass., *Moulinsia*, Agass., *Scutellina*, Agass., *Echinocyamus*, Van Phels., *Fibularia*, Lamk., *Lenita*, Desor.

Types. *Clypeaster rosaceus*, Lamarck. *Scutella subrotunda*, Lamarck. *Echinarachnius placenta*, Gmelin.

Family 12. ECHINOCORIDÆ.—Test thick, oval and elevated, sometimes cordate; ambulacral areas narrow; poriferous zones narrow, pores unigeminal; test covered with small tubercles, which are perforated and crenulated. One genus has a marginal fasciole. Mouth opening small, excentral, transversely oblong. Anal opening nearly of the same size, oblong, marginal, or supra-marginal. Apical disc elongated, nearly central, with four genital pores; the cordate forms have an anterior central depression. The species are all extinct, and are limited to the Cretaceous rocks.

Types. *Echinocorys vulgaris*, Breynius. *Holaster sub-globosus*, Leske. *Cardiaster granulatus*, Goldfuss.

Family 13. SPATANGIDÆ.—Test thin, oval, oblong or cordiform, and satisfactorily exhibiting the bilateral symmetry of the *Echinoidea*. The anal opening is posterior and supra-marginal, and is closed by a complicated series of small plates. The apices of the ambulacral areas are united at the summit of the test. The anterior single ambulacrum has a different structure from the antero- and postero-lateral pairs, and is in general lodged in a depression of the test, which extends to the anterior border, forming the anteal sulcus; the

test is extremely thin, and is covered with small tubercles, which support hair-like spines. Besides these, there are some larger crenulated and perforated tubercles, which support large spines. There are two or four genital pores, which are sometimes placed close together, but are in other genera apart. The eye-plates are five in number, and are placed at the apices of the ambulacra, in a pentagonal form, around the genital plates. On the surface of the test of some *Spatangidæ* certain delicate lines called *fascioles* are observed, having a smoother appearance than the tubercular surface of the test: they are furrows, strewn with microscopic tubercles, and destined to carry very delicate spines, which, when seen under the microscope, appear to have the same structure as the *Pedicellariæ*. The fascioles have a different disposition in each genus, and afford a good character in making definitions of the same. When the fasciole surrounds the ambulacral petals like an undulating groove, as in *Hemiaster*, *Schizaster*, &c., it is said to be *peri-petalous*; when it surrounds the single ambulacrum, as in *Amphidetes*, it is *internal*; when it extends along the sides, as in *Schizaster*, it is *lateral*; when it surrounds the circumference of the test, as in *Pericosmus*, it is *marginal*; when it is limited to the base of the anal opening, it is *sub-anal*. Sometimes, in the same genus, more fascioles than one exist; thus the sub-anal and peri-petal are frequently associated together.

Types. *Spatangus purpureus*, Müller. *Brissus lyrifer*, Forbes. *Brissopsis Duciei*, Wright.

Family 1—CIDARIDÆ.

Test thick, turban-shaped, more or less depressed at the oral and anal apertures. Mouth opening wide, central; peristome circular or pentagonal, but without notches; aperture closed by a buccal membrane, covered with small spines, metamorphosed into imbricated scales, upon which the pores from the zones are prolonged.

Opening for the apical disc very large; the disc composed of five large equal-sized angular genital plates, and five ocular plates; anus opens in the centre of the disc, directly opposite to the mouth; anal membrane clothed with small angular plates, unequal in size, and variable in number.

Ambulacral areas extremely narrow, composed of a great number of very small plates, which have only minute tubercles, or rows of small granules on their surface, but never supporting tubercles carrying primary spines.

Inter-ambulacral areas very wide, composed of large plates, rarely more than from six to eight in one column; the external surface of each plate carries a large perforated tubercle, raised on a prominent boss, and encircled by an areola, which has either a round or oval form; the areola is surrounded in general by an elevated margin, on which are placed a circle of granules, the scrobicular circle, usually larger than those filling the miliary zone.

The poriferous zones are narrow, and extend without interruption from the margin of the buccal membrane to the apical disc; the pores in general are strictly unigeminal, but in one genus they are bigeminal; the pores are contiguous, or separated by septa more or less thick.

The jaws, five in number, form a very powerful lantern, which is moveably connected with, and supported by, a series of calcareous processes or auricles, arising from the inner surface of the test; the teeth are more simple, and the lantern less complicated, however, than in the *Echinidæ*.

The spines in this family are large, strong, cylindrical, fusiform, prismatic, club-shaped, or flattened; their surface is sometimes covered with longitudinal lines, or with prickles or granules, which in general have a linear arrangement, or they are more or less irregularly disposed; but the form and sculpture of the spine has invariably, as far as is known, a specific value, its dominant characters being always persistent.*

* The form and general character of the spine should, in every case, be examined with scrupulous attention, and, whenever in fossil species the spines are found attached to their test, the facts connected therewith should be noted with the greatest accuracy. The neglect of this caution has been the cause of much confusion, and led to some serious errors, as will appear in the sequel.

The *Cidaridæ* are the most ancient type of the Echinoidea. The remains of different forms of this family are found in the Silurian, Devonian, and Carboniferous rocks, as well as in those of the Secondary and Tertiary periods. In his valuable Synopsis, M. Desor describes six genera in this tribe: these are *Cidaris*, Klein.; *Rabdocardis*, Desor; *Diplocardis*, Desor; *Porocardis*, Desor; *Goniocardis*, Desor; *Palæocardis*, Desor. Of this number three are extinct—*Diplocardis*, *Porocardis*, and *Palæocardis*; two contain both extinct and living forms—*Cidaris* and *Rabdocardis*; and one is only found living—*Goniocardis*.

*Genus—CIDARIS, Klein. 1734.*ECHINUS, *Linnaeus, Hissenger, &c.*ECHINITES or HISTRIX, *Bourguet.*CIDARIS, *Klein, Leske, DeFrance, Blainville, Agassiz, Desor.*CIDARITES, *Lamarck, Goldfuss, Gray, Desmoulins.*

General form circular or turban-shaped; test thick, sub-spheroidal, nearly equally flattened on the under and upper surfaces.

Ambulacral areas very narrow and undulated, supporting only minute granuloid tubercles, or small granules, disposed in two, four, or six close-set rows.

Inter-ambulacral areas at least four times the width of the ambulacral, furnished with two rows of large primary tubercles, from four to six in a row,—rarely there are ten.

The tubercles are perforated; the bosses are large and prominent, and their summits are smooth or crenulated; the areolas are wide, and in general are deeply excavated; they have a round or oval figure, and their elevated margin is in general surrounded by a complete circle of granules (the scrobicular circle).

The miliary zones are concave, and more or less wide in proportion to the size of the primary tubercles; they are filled with numerous rows of small, close-set granules.

The poriferous zones are narrow; the pores are unigeminal and contiguous; they are separated by septa more or less thick.

The spines are robust and massive, cylindrical, fusiform, or claviform; their surface is covered with longitudinal lines, or furnished with prickles, granules, or other asperities, which often assume a linear arrangement.

The mouth opening is circular or pentagonal, without notches; the buccal membrane is covered with imbricated scales, on which the pores from the zones are prolonged.

The apical disc is large, and is composed of pentagonal, nearly equal-sized, genital plates, and triangular ocular plates.

The lantern is powerful, composed of massive pyramids, the branches of which are not united at their summits; the teeth are canaliculated, and formed of a folded plait, without a carina on the inner surface.

Notwithstanding the limitation of the genus *Cidaris* of Klein., by Lamarck, Goldfuss, Agassiz, and Desor, it still forms an extensive group of Urchins, which range from the Palæozoic rocks into our modern seas.

This genus divides itself into two types; in the one, the mammillary bosses have smooth summits; in the other, they are more or less crenulated.

THE FIRST TYPE.—*Tubercles with smooth and uncrenulated bosses, exist in our present seas, and are found fossil in the Carboniferous, Triassic, Cretaceous, and Tertiary rocks.*

THE SECOND TYPE.—*Tubercles with the summits of the bosses more or less crenulated, are found in the Triassic and Oolitic rocks.*

There are some exceptions to these rules, for *Cidaris marginata*, Goldfuss, and *Cidaris lævigata*, Desor, both from the Coral Crag, have smooth bosses; and some species from the Neocomian and Cretaceous strata are said to have the summits of these eminences crenulated.

A. *Cidaris from the Lias.*

CIDARIS EDWARDSII, *Wright*. Pl. I, fig. 1 *a, b, c, d, e, f*.

CIDARIS EDWARDSII, *Wright*. *Annals and Magazine of Natural History*, 2d series, vol. xiii, p. 161, pl. 11, fig. 1 *a—f*.

Test crushed; the true form therefore unknown. Ambulacral areas narrow, gently flexed, and furnished with two rows of small perforated marginal tubercles, and a median row of smaller tubercles irregularly interspersed amongst them; the marginal tubercles being alternately larger and smaller; poriferous zones wide, with large, closely approximated, oblong pores; inter-ambulacral areas about four times the width of the ambulacral, with two rows of large primary tubercles, the areolas of which are confluent throughout; miliary zones wide, and covered with numerous small granules; primary spines long, showing a complex structure; secondary spines short, with blunt apices; the surface of both covered with delicate longitudinal lines; mouth armed with five powerful jaws, each having carinated ridges on their convex surface; upper part of the test unknown.

Description.—The great argillaceous deposits of the Oolitic group—the Lias, the Oxford Clay, and the Kimmeridge Clay—were formed under conditions which appear to have been unfavorable to the development of Urchin life; for, although these rocks have been industriously explored, they have hitherto yielded very few remains belonging to the Echinoidea: this remark does not apply only to the English Oolitic group, but is applicable to the whole series as developed on the continent of Europe. Although a few forms of *Cidaridæ* lived in the Silurian, Devonian, Carboniferous, Permian, and Triassic seas, still it was in the Jurassic ocean that they existed in any considerable numbers; and this fact gives increased interest to the study of the anatomy of these Oolitic representatives of this most beautiful family, one of the oldest of which we have figured in Pl. I, fig. 1. It is much to be regretted that the specimen before us is the only one of the species that has been found in Gloucestershire in anything like a state of preservation, a few fragments of its test having been rarely collected in two or three other localities. At Lyme Regis one

specimen of this species, with some of its spines attached, has been discovered; and one was found in the Lias of Yorkshire; but these are the only examples with which we are acquainted. The specimen which forms the subject of our figure was discovered by G. E. Gavey, Esq., C.E., whilst cutting through the shales of the middle Lias, to form the Oxford, Worcester, and Wolverhampton Railway; the zone of Lias in which it was found was that containing *Ammonites maculatus*, Young and Bird; it was associated with three or four other remarkable species of *Asteriadae*, *Ophiuridae*, and *Crinoidae*, in a high state of preservation, and which will be figured and described in the future parts of this Monograph. The conditions under which these Echinoderms were found are curious and deserve notice. *Uraster Gaveyi*, Forbes, was found lying on the upper surface of a slab of sandstone, twelve inches thick, at twenty-five feet below the surface, associated with fragments of *Extracrinus*, *Ammonites*, and other fossils. All the specimens of *Tropidaster pectinatus*, Forbes, and *Cidaris Edwardsii*, Wright, were found imbedded in the under surface of a thick slab of ironstone, at twenty feet below the surface. Almost all the specimens show the under surface uppermost, and most of them had their spines attached to the spinigerous tubercles. *Cidaris Edwardsii*, when first discovered, was so entirely covered with spines, that the inter-ambulacral plates were almost concealed. For further details relating to this section, and the fossils found therein, the reader is referred to Mr. Gavey's paper.*

The specimen is crushed and flattened, and lies with its mouth and jaws uppermost. At our request, Mr. Baily, in his beautiful drawing, has restored the urchin to its globular form; but it must be added, that all the parts of the test, and the details he has given of its structure, are faithful copies of the original. The ambulacral areas are provided with two rows of small perforated tubercles on the margin of the areas, each plate thereof developing alternately a smaller and a larger marginal tubercle (Pl. I, fig. 1 *b*); amongst these a row of small granules are scattered somewhat irregularly throughout the areas. All these tubercles supported short, stout, blunt-pointed spines (fig. 1 *d, e*), the surface of which is delicately sculptured with longitudinal lines: many of these spines are seen *in situ* in the specimen, although many have been removed to expose the surface of the test. The poriferous zones are wide, and follow the gentle flexures of the ambulacral areas; the pores are large and oblong, and the two pores forming a pair are separated by very thin partition walls, a circumstance which forms a good diagnostic character (Pl. I, fig. 1 *b*); there are five pairs of pores opposite each of the large tubercular plates.

The inter-ambulacral areas are four times the width of the ambulacral; they are composed of rather narrow tubercular plates, which support two rows of primary tubercles, set, therefore, rather closely together, in a vertical direction, so that the areolas are all confluent above and below (Pl. I, fig. 1 *b*); the miliary zone is wide, and filled with six rows of minute, close-set, perforated tubercles, each of which is raised on an elevation of the test;

* 'Quarterly Journal of the Geological Society,' vol. ix, p. 29, with sections of the Railway Cuttings.

the semi-circlet surrounding the outer and inner margin of the areolas is composed of granules very little larger than those which fill up the miliary zone. The primary tubercles are of moderate size; the number in each column is uncertain; but, judging from the eight tubercular plates still remaining in an imperfect column, and estimating the number necessary to complete the same, it is probable that the perfect test had from twelve to fourteen tubercles in each row, gradually increasing in size from the peristome upwards; they are proportionately small when compared with the size of the test itself. The areolas are oblong, and the narrowness of the plates causes them to open into each other above and below; the bosses are neither large nor prominent, but the crenulations on their summits (Pl. I, fig. 1 *b*) form a well-marked circlet of granules, which surrounds the base of the tubercles (fig. 1 *c*); these are small, with deep and wide perforations on their summits. The peristome is wide, and, in the only three specimens we know, part of the dental apparatus is preserved *in situ*: the portion remaining in the figured specimen consists of three prominent jaws (fig. 1 *a*); one of these is shown in fig. 1 *g*. It is convex, and the external surface is strengthened by three prominent ridges; the teeth are large, but are all fractured. As the test rests on its upper surface, the ovarial plates and dorsal surface are concealed from observation.

The spines remaining *in situ* on the test are of two kinds (fig. 1 *a*); those articulated with the primary tubercles, the primaries; and those articulated with the smaller tubercles, the secondaries. The primary spines exhibit a peculiar structure (fig. 1 *f*); the head is large, gradually increasing in diameter from the articular cavity to the circular band; the rim of the acetabulum is coarsely and deeply crenulated, and the raised band is narrow, prominent, and finely milled; the neck tapers gradually from the band to the point where it joins the stem, which has the same structure as the head; and the surface is delicately sculptured with fine longitudinal lines (fig. 1 *f*).

The stem is united to the neck by an oblique harmonia suture; in those spines which are denuded of their external layer, it has a horny semi-transparent aspect; but when this external layer is present, its surface is seen, with a pocket lens, to be sculptured with fine longitudinal lines; besides these, there are a number of small processes arranged in rows, the points of which have a direction forwards, but their linear arrangement is by no means regular; the stem is long, slender, and circular, its length in proportion to the diameter of the test has not been ascertained, as all the spines are fractured. The secondary spines are very uniform in size and structure, and are preserved in abundance in the specimen before us (fig. 1 *a*). Each of the minute tubercles of the ambulacral areas, and of the miliary zones, carried one of these spines, which measure about $\frac{6}{20}$ ths to $\frac{7}{20}$ ths of an inch in length; they are stout and blunt pointed, tapering very little from the milled band to the apex, and having their surface covered with microscopic longitudinal lines (fig. 1 *d, e*).

Affinities and differences.—This *Cidaris* belongs to the same group as *Cidaris Fowleri*,

Wright, and *Cidarites maximus*, Münster, but it presents many important characters by which it is distinguished from both. From *Cidaris Fowleri* it differs in wanting the regular close-set row of marginal granules, with the four internal rows of minute granules in the ambulacral areas, which form so fine a character in that Inferior Oolite species (Pl. I, fig. 4 *e*) ; the irregular distribution of the small tubercles in these areas in *Cidaris Edwardsii* forms a marked distinction between them : the poriferous zones are occupied by large pores, separated from each other by thin septa ; in *Cidaris Fowleri* the pores are small, oblong, and separated by a thick portion of the test (fig. 4 *e*). The tubercular plates in *Cidaris Edwardsii* being narrow, there are consequently a greater number of primary tubercles in the inter-ambulacral areas : the areolas, likewise, are oblong, and always confluent in the vertical direction ; whereas in *Cidaris Fowleri* the areolas are nearly circular (fig. 4 *e*), and each is surrounded by a circle of granules. The inter-tubercular space or miliary zone in *Cidaris Edwardsii* is filled with small perforated tubercles, but in *Cidaris Fowleri* the same space is occupied by small imperforate granules, more numerous, but less regular in size and distribution (fig. 4 *e*) : the spines in *Cidaris Fowleri* are stout, and have well-developed rows of forward-directed prickles (fig. 4 *d*) ; whereas in *Cidaris Edwardsii* they are long and slender, with small irregular elevations of the surface, which is likewise sculptured with microscopic longitudinal lines.

Locality and Stratigraphical position.—This fine urchin was discovered in the upper shales of the Lower Lias, or Middle Lias, by G. E. Gavey, Esq., C.E., at Mickleton tunnel, near Chipping Campden, in the zone of that formation containing *Ammonites maculatus*, Young and Bird. The bed which yielded *Cidaris Edwardsii* contained likewise other species of Echinoderms in a fine state of preservation : these were—

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|---|--|
| <i>Cidaris Edwardsii</i> , Wright | <i>Tropidaster pectinatus</i> , Forbes |
| <i>Hemipedina Bowerbankii</i> , Wright, | <i>Ophioderma Gaveyi</i> , Wright |
| plates of | <i>Extracrinus robustus</i> , Wright |
| <i>Uraster Gaveyi</i> , Forbes | „ Two species undetermined. |

Besides these Echinodermata, 40 species of Conchifera, 8 species of Gasteropoda, and 10 species of Cephalopoda, with Serpulæ, and 2 new species of *Pollicipes*, were associated with the same. For more details, the reader may consult Mr. Gavey's paper.* Isolated plates of *Cidaris Edwardsii* have been collected from the same zone of the Lias in other localities in Gloucestershire, but the specimen we have figured is the only one which displays the true character of the species. Professor Morris has kindly communicated a *Cidaris* with spines, collected from the Lias at Lyme Regis, which has proved to be a small specimen of *Cidaris Edwardsii* : this beautiful fossil shows many of the long slender

* 'Quarterly Journal of the Geological Society,' vol. ix, p. 29.

spines *in situ* on the slab. Like the specimen we have figured, it lies crushed upon its upper surface; the mouth-opening contains some of the jaws and teeth. A crushed *Cidaris*, on a slab of Lower Lias shale, from Bockeridge Common, Gloucestershire, has been communicated by Professor Buckman. The areolas in this specimen are oblong, and some of them are entirely surrounded by a scrobicular circle of small, close-set granules, whilst a few only are confluent. The character of the bosses, however, with their flat, deeply-crenulated summits, and small, perforated tubercles, convince me that it is *Cidaris Edwardsii*. Had a doubt existed, it would have been removed by the discovery of one of the primary spines laid along the concealed portion of the test, which exhibited the crenulated head and milled neck, with longitudinal lines, so very characteristic of this Middle Lias urchin. The entire confluence of the areolas in the large specimen may prove to be an adult character; as the crowding together of so many tubercles in each column of tubercular plates, may have necessitated the absorption of a portion of the scrobicular circles, which existed in juvenile individuals. On this interesting slab there are two separate vertebræ of an Ichthyosaurus. Professor Phillips, in his 'Geology of Yorkshire,' figures a spine, Pl. XIII, fig. 17, which resembles those of our urchin, but its characters are not given in detail. Goldfuss* mentions spines, which he erroneously referred to *Cidaris Blumenbachii*, that were collected from the "Gryphitenkalke der Lias-Formationen bei Pretzfeld und Theta, und ist der einzige Echinit, der in Baiern dieser Formation angehört." One of the "aculeorum variæ formæ fragmenta" (i, fig. 4, Pl. XXXIX) so very much resembles the spines attached to the test of *Cidaris Edwardsii*, that it is possible it may be the same. Quenstedt† has found spines in the Lias, "am Donau-Mainkanal bei Dörlbach," one of which (Pl. XLVIII, fig. 30) resembles those of our species. Another spine, from the Inferior Lias of Dasslingen, Wurtemberg (figs. 31, 32), has fine longitudinal lines, with small wart-like eminences, not arranged in rows. All these Liassic urchins present nearly allied characters, and prove that *Cidarites*, belonging to the same natural group, and if not to the same, at least to allied species of the genus *Cidaris*, lived over an extensive area during the deposition of the upper shaly beds of the Lower Lias, or the Middle Lias of Continental geologists.

In the Scarborough Museum I found a beautiful specimen of this species, with many spines attached, as large as the one figured in this Monograph. It was collected from the Middle Lias of the Yorkshire coast.

This species is dedicated to Professor Milne Edwards, of the Museum of Natural History at the Jardin des Plantes, Paris.

* 'Petrefacta Germaniæ,' vol. i, p. 117, tab. 39, fig. 4 c—k.

† 'Handbuch der Petrefaktenkunde,' p. 574, pl. 48, figs. 28—32.

CIDARIS ILMINSTERENSIS, *Wright*, n. sp. Pl. V, fig. 6 *a, b*.

Test large, form unknown; ambulacral areas narrow, with two marginal rows of small granules; poriferous zones narrow, pores nearly round, and closely approximated; inter-ambulacral plates large, as deep as they are wide; areolas large, circular, surrounded by a complete scrobicular circle of small granules; mammary bosses not much elevated; summits deeply crenulated; tubercles of moderate size.

Description.—We only possess, of this species, one tubercular plate, and a portion of a second, with one half of the corresponding part of the ambulacral area, but still this fragment is sufficient to enable me to give its diagnosis, and point out those characters by which it is distinguished from its congeners. The test must have attained a size quite equal to that of *Cidaris Fowleri*; the ambulacral areas are very narrow, and have only two rows of marginal granules, there being one granule on each alternate plate; the poriferous zones are narrow, the holes are contiguous and nearly round, and each pair has a thin septum separating them (Pl. V, fig. 6 *b*); there are fifteen pairs of holes opposite each large inter-ambulacral plate.

The inter-ambulacral areas are composed of large, nearly quadrate, tubercular plates (fig. 6 *b*); the number of the primary tubercles is unknown; the areolas are large and circular, and are surrounded by a scrobicular circle, composed of very small granules (fig. 6 *b*); down the inter-tubercular space there were other four rows of granules of nearly the same size; the scrobicular circle extends so very near to the poriferous zones, that there is no granular space intervening between them (fig. 6 *b*); the mammary boss is not very prominent, but its summit is sculptured with well-defined crenulations; the tubercle is of moderate size, and has a wide perforation in its summit.

Affinities and differences.—This species differs from *Cidaris Edwardsii* in having a complete scrobicular circle of granules around the areolas, in the narrowness of the ambulacral areas, with only two marginal rows of granules, and in the scrobicular circle abutting against the poriferous zones without a row of granules separating them; the smallness of the holes in the zones, and their proximity to each other, is another point of difference. Compare Pl. I, fig. 1 *b*, with Pl. V, fig. 6 *b*.

Cidaris Iminsterensis differs from *Cidaris Fowleri* in having no granules between the scrobicular circle and the zones, the latter having two or three rows (fig. 4 *e*, Pl. I); the breadth of the ambulacra, and its four rows of granules, and the wide poriferous zones, with the holes kept far apart by very thick septa, serve further to distinguish that Inferior Oolite form from this Upper Lias species.

Locality and Stratigraphical position.—It was collected by Mr. Moore in the Upper

Lias of Ilminster, and was found associated with *Ammonites serpentinus*, Schlotheim, *Ammonites annulatus*, Sowerby, and other Upper Lias fossils. The fragment figured was the only one ever found.

B. *Species from the Inferior Oolite.*

CIDARIS FOWLERI, *Wright*. Pl. I, fig. 4 *a, b, c, d, e*.

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| CIDARIS CORONATA. | Murchison's Geology of Cheltenham, 2d ed., by Buckman and Strickland, p. 73. |
| — — | Morris's Catalogue of British Fossils, Inf. Oolite, Cotteswold Hills, 1st ed., p. 49. |
| — FOWLERI. | Wright, Annals and Magazine of Natural History, 2d series, vol. viii, p. 246, pl. 11, fig. 5 <i>a, b</i> . |
| — — | Desor's Synopsis des Echinides Fossiles, p. 6, tab. 3, fig. 13. |
| — — | Morris's Catalogue of British Fossils, 2d ed., p. 74. |

Test spheroidal, depressed at both poles; ambulacral areas prominent, flat, narrow, and slightly undulated, with two marginal rows of small, equal-sized, close-set granules, and two rows of central, irregular, and almost microscopic granules, with still smaller granules interspersed between them; poriferous zones broad, each as wide as the ambulacra; pores oblong, set wide apart, with a thick septum between the two pores of each pair; inter-ambulacral areas with two rows of primary tubercles, six to eight in each row, all the areas surrounded by a complete scrobicular circle of granules; miliary zone wide, filled up with small close-set granulations; spines large, covered with irregular rows of forward-directed prickles.

Dimensions.—Height one inch and one tenth, transverse diameter one inch and eight tenths; two crushed specimens, the relative dimensions of which, therefore, cannot be accurately ascertained, measure considerably more.

Description.—This beautiful *Cidaris*, which, when first discovered, more than fifteen years ago, was supposed to be the *Cidaris coronata*, Goldfuss, and was catalogued as such in the works cited in the synonyms of the species. Apart from the organic characters to be pointed out in the sequel, it is a form which has hitherto only been found in the Inferior Oolite, whilst *Cidaris coronata*, Goldf., as constantly characterises the upper zone of the middle division of the Jurassic group. In the Swiss Jura, for example, it is found in the "terrain à chailles," a local formation, the greatest similarity to which, it appears, is the lower Calcareous Grit of England; in the Coral Rag, or Argovien, of Randen, of Birmansdorf, of the valley of the Birse, and of the same stage in Bavaria and

Wurtemberg. It is found likewise in the Coral Rag of Besançon, in the Corallian stage at Chatel-Censoir, and at Druyes, Yonne, in Ain, Isere, and other departments of France. On the Continent *Cidaris coronata* is therefore a characteristic Coral Rag urchin; but it has never yet been found in this or any other stage in England.

The ambulacral areas in *Cidaris Fowleri* are slightly prominent and undulated; they are nearly uniform in width throughout, and are furnished with two marginal rows of nearly equal-sized, close-set granules (Pl. I, fig. 4 *e*), which become larger near the peristome; within these marginal pairs are two other rows of smaller granules, with other microscopic granulations interspersed among them; these inner rows gradually disappear above and below, and the marginal rows then come into juxtaposition; the poriferous zones form wide ribbon-like depressions, nearly equalling in breadth that of the area (Pl. I, fig. 4 *e*); the pores are oblong, and the holes forming a pair are set widely apart, with a thick septum, equalling the long diameter of the pores, separating them from each other. In the large specimens there are seventeen pairs of pores opposite each of the large tubercular plates.

The inter-ambulacral areas are formed of large plates, nearly as broad as they are long (Pl. I, fig. 4 *b*), their lines of sutures being very distinct in young as well as in old individuals; each column consists of from six to eight tubercular plates, and each plate externally has a large flat, nearly circular areola (Pl. I, fig. 4 *e*), slightly furrowed towards its outer border; in the centre rises abruptly the mammillary boss, the summit of which is sculptured with about fifteen deep crenulations; from the interior of these rises a short cylindrical stem, which terminates in a small hemispherical, deeply perforated, spinigerous tubercle, the diameter of the tubercle slightly exceeding that of its stem; the margins of the areolas are bounded by a circle of fifteen scrobicular granules (fig. 4 *e*), which are arranged with much regularity, each granule having a microscopic circlet of granules around its base; the scrobicular circles on the upper half are more fully developed than those on the lower half of the test; from the equator upwards, each areola has its own distinct scrobicular circle; but from that line to the peristome, one scrobicular line of granules separates two areolas above and below from each other; the miliary zone is wide, and is thickly covered with very small granules, which diminish in size from the scrobicular circle to the median suture; among the principal granules filling up this interspace are others of still smaller size; the entire granulation does not observe much regularity, although it follows lines which somewhat describe the tract of the median suture: the space between the scrobicular circle and the poriferous zones is not so wide as that between the scrobicular circle and the centro-sutural line; this space is likewise filled up by granulations of the same size and character as those which fill up the median miliary zone.

The mouth opening measures half the diameter of the test at the equator, and the peristome has a pentagonal form. (Pl. I, fig. 4 *a*.) In two of the specimens before us, the lantern is preserved, consisting of five strong pyramidal jaws, armed with conical teeth.

(Pl. I, fig. 4 *a*.) The plates composing the apical disc are absent in all the specimens hitherto found.

The spines (Pl. I, fig. 4 *d*) are large; the milled band below the neck is close to the cup-like articulating cavity; the neck increases slightly in thickness, and the nearly round stem is covered with longitudinal rows of short, sharp prickles, which have their points directed forwards; the stem of the spine is slightly flattened. Fortunately one specimen was found by Mr. Gibbs, of the Geological Survey, with the spine *in situ* attached to the test, so that all doubt about the species to which it belongs is removed by this discovery. The specimen with the spine attached is in the Geological Museum in Jermyn Street. The secondary spines are short, and blunt pointed, but only a very few of these have been found. Those belonging to the scrobicular circle are larger than those which armed the small granules.

Affinities and differences.—This urchin very much resembles an undescribed species collected by M. De Loriere, from the Inferior Oolite of the department of the Sarthe. There are some slight shades of difference between the French specimens and *Cidaris Fowleri*, but the general resemblance between them is so very great, that we believe them to be identical. The rock from which the French urchin was collected is referred to the “*étage Callovien* ;” but it contains several species which hitherto have only been found by us in the Inferior Oolite of England, as *Holactypus gibberulus*, Agassiz, *Pygurus depressus*, Agassiz, and *Clypeus Agassizii*, Wright. From these facts we are disposed to think that there must be a mistake about the true stratigraphical position of the formation from whence these urchins have been collected.

In the general structure of the test, and in its ornamentation, *Cidaris Fowleri* closely resembles *Cidaris Orbignyana*, Agassiz,* from the Kimmeridge Clay of Havre. If the palæontologist had to decide the species from the anatomy of the test alone, he would have great difficulty in distinguishing the one form from the other; but fortunately the spines of both are now known, which settles the question as to the specific difference existing between them. We have the test and spines of *Cidaris Orbignyana* before us, but the reader will find fine figures of both in M. Desor’s Synopsis, where it is admirably figured for the first time, and to this work we beg to refer the reader. Compare, for example, Pl. III, fig. 13, spine of *Cidaris Fowleri*, with Pl. VIII, figs. 7—9, the spine of *Cidaris Orbignyana*.

In the general form and structure of the test, *Cidaris Fowleri* resembles *Cidaris florigemma*, but it differs from that well-known Coral Rag species in the flatness of its ambulacral areas, in the greater breadth of the poriferous zones, its smaller primary tubercles, the depth and character of the crenulations on the bosses, and, above all, in the structure of its spines. Compare Pl. I, fig. 4 *d*, with Pl. II, fig. 2 *a*.

* A beautiful figure of this fine species is published in M. Desor’s ‘Synopsis des Echinides Fossiles,’ pl. 1, fig. 3; pl. 8, figs. 7—9, contains the spines.

It is distinguished from *Cidaris Edwardsii* by the width of the poriferous zones, and the thickness of the septum which separates the pores composing a pair; by the circular form of the areas, and the complete scrobicular circle of granules that surround and limit them in *Cidaris Fowleri*: whereas in *Cidaris Edwardsii* the areolas are oblong and confluent. In the structure of the spines there are likewise important differences. Compare Pl. I, fig. 1 *f*, with fig. 4 *d*.

Cidaris Fowleri is distinguished from *Cidaris Bouchardii* (Pl. I, fig. 2 *a, b*, and Pl. VIII, fig. 3 *a, b, c*), which occurs with it in the same bed, by the latter being in general a rather more depressed form, its ambulacral areas having only two marginal rows of granules; the poriferous zones being much narrower, and the areolas of the primary tubercles more deeply sunk in the plates; the tubercles themselves are larger, the scrobicular circle is more prominent, and the granulations in the miliary zone are fewer and larger.

Cidaris Fowleri differs from *Cidaris Wrightii* (Pl. I, fig. 3), which is likewise found rarely in the Pea Grit, by the latter having a very thick test, large primary tubercles, with very small perforations; the poriferous zones are narrow, and the ambulacral areas have only two rows of marginal granules (fig. 3 *c*). Moreover, it is a much smaller and a more inflated form than *Cidaris Fowleri*.

Only one tubercular plate of *Cidaris Ilminsterensis* from the Upper Lias (Pl. V, fig. 6 *a, b*) is known; but so finely are the specific characters defined upon that fragment, that we are enabled to point out the differences between these two species, so nearly related to each other in time. In *Cidaris Ilminsterensis* the scrobicular circle of granules abuts very close upon the poriferous zones, which are narrow, and have the pores placed close together; whereas in *Cidaris Fowleri* there is a considerable granulated space between the scrobicular circle and the poriferous zones, which are wide, and have their pores placed far asunder.

Locality and Stratigraphical position.—*Cidaris Fowleri* was obtained from the Pea-grit of the Inferior Oolite at Crickley Hill, Gloucestershire. It has been likewise found in the same bed at Birdlip and Leckhampton Hills. The remarkable rock in which these Cidarites are found seems to have been a tranquil littoral deposit in shallow water, as the most of the Echinoderms are finely preserved, with all the sharpness of their sculpture quite intact. Associated with this urchin are—

Cidaris Bouchardii, Wright
Cidaris Wrightii, Desor
Diadema depressum, Agassiz
Echinus germinans, Phillips
Polycyphus Deslongchampsii, Wright

Hemipedina Bakeri, Wright
Hemipedina perforata, Wright
Hemipedina tetragramma, Wright
Hemipedina Waterhousei, Wright
Hemipedina Bonei, Wright

BRACHIOPODA.

Terebratula simplex, Buckman. (*Terebratula trigonalis*, Lhwydd.)

Terebratula plicata, Buckman.

Terebratula submaxillata, Davidson.

CEPHALOPODA.

Ammonites corrugatus (*Murchisonæ*), Sowerby.

This species is dedicated to our friend, Charles Fowler, Esq., who generously added to our collection the fine specimen figured in detail.

CIDARIS BOUCHARDII, *Wright*. Pl. I, fig. 2 *a, b, c*; Pl. VIII, fig. 3 *a, b, c*.

CIDARIS ELEGANS. Morris's Catalogue of British Fossils, 1st ed., p. 49, 1843.

— BOUCHARDII. Wright, Annals and Magazine of Natural History, 2d series, vol. xiii, p. 163, pl. 11, fig. 2.

Test circular, much depressed; ambulacral areas narrow and flexuous; poriferous zones deep and narrow; inter-ambulacral areas with two rows of primary tubercles, six to seven in each row; areolas circular, deeply excavated, and entirely surrounded by an elevated scrobicular circle of large granules; a zigzag depression extends through the centre of the inter-ambulacral areas; centro-sutural line strongly marked.

Dimensions.—A large specimen: Height, nine tenths of an inch; transverse diameter, one inch and seven tenths. A moderate-sized specimen: Height, eleven twentieths of an inch; transverse diameter, one inch and two tenths.

Description.—This beautiful urchin was entered in the Catalogue of British Fossils as *Cidaris elegans*, Goldfuss. A comparison, however, of several individuals of *Cidaris Bouchardii*, with typical specimens of Goldfuss's species, kindly sent us by our friends, Prof. Roemer, of Bonn, which he had identified with the original *Cidaris elegans*, Goldf., in the Bonn Museum, and Dr. Fraas of Stuttgart, has enabled us to separate these two forms.

The test of *Cidaris Bouchardii* is circular, and much depressed, from the great flattening of both of the upper and under surfaces; the ambulacral areas are narrow, and much undulated; they have two marginal rows of small granules, with a few more minute ones scattered irregularly between them; the poriferous zones are narrow and slightly sunk; the holes are circular and contiguous, and are separated by a prominent granule rising from the surface of the septum. (Pl. I, fig. 2 *c*.)

The inter-ambulacral areas are five times the width of the ambulacral (Pl. I, fig. 2 *a, b, c*; Pl. VIII, fig. 3 *a, b*); the primary tubercles are small, and from six to seven in each row;

the areolas are circular and deeply sunk (fig. 2 c); around the margin of each there is a complete elevated scrobicular circle of small close-set granules; the mammary boss rises abruptly from the centre, and its summit is sharply crenulated; the tubercle is proportionately small, and deeply perforated with a small hole; the elevation of the scrobicular circle gives an excavated air to the areolas of this species, and produces, at the same time, a marked zigzag depression down the centre of the areas; the miliary zone is wide, and filled with six rows of fine granules, rather smaller in size than those forming the scrobicular circles.

The mouth opening is small, being less than one half the diameter of the test. In a small specimen measuring $\frac{1}{2}\frac{7}{10}$ ths of an inch in diameter, that of the peristome was a little more than $\frac{7}{20}$ ths of an inch. This opening lies in a slight depression of the under surface; the peristome has a pentagonal form; and the ambulacral areas retain their full diameter to the margin of the same.

The apical disc is absent in all the specimens; but the dimensions of the aperture occupied by these plates is very considerable, being more than half the diameter of the test. In a small individual before us, measuring $\frac{1}{2}\frac{6}{10}$ ths of an inch in diameter, the diameter of the opening for the apical disc measures $\frac{9}{20}$ ths of an inch. In this small specimen, in fine preservation, which we collected in Dorsetshire, the margin of the discal opening is entire, so that we can state with certainty its comparative measurement, with that of the equatorial diameter of the test itself. It is the only individual that has afforded this information, all the others being more or less crushed, broken, or otherwise distorted.

Affinities and differences.—*Cidaris Bouchardii* has been mistaken for, and registered as *Cidaris elegans*, Goldf., but, although it has some affinities with that species, its differences are numerous and important. The ambulacral areas in both species have two rows of marginal granules, and the poriferous zones in both are of about the same width and depth. In the inter-ambulacral areas the differences are conspicuous: the number of tubercles is greater in *Cidaris Bouchardii* than in *Cidaris elegans*; and the sunk areolas, with their elevated scrobicular circle, form another important distinction between our urchin and the German form. The tubercles, moreover, are larger and much more prominent in *Cidaris elegans*: it likewise belongs to a higher stratigraphical zone, the specimens before us having been found in the Coral Rag of Streitberg and Sigmaringen. Another fact, of a negative character it is true, but not the less valuable in palæontological investigations, is this, that we have never seen spines at all approaching the curious and singular character exhibited by those of *Cidaris elegans* in the Inferior Oolitic rock, from whence our urchins have been collected.

Cidaris Bouchardii resembles *Cidaris coronata*, Goldf., in many points. It has the depressed form, the flexuous ambulacra, and the prominent scrobicular circle of this German species, but is distinguished from it by the following characters: The equatorial portion of the ambulacral areas in *Cidaris coronata* has four rows of granules, which diminish to two

rows, above and below ; these areas, therefore, are enlarged in the middle, and taper towards the peristome and towards the apical disc, whereas in *Cidaris Bouchardii* they retain very nearly a uniform width throughout. There are seldom more than four tubercular plates in each column in *Cidaris coronata* ; whereas in *Cidaris Bouchardii*, although a small species, the numbers are from six to seven. In *Cidaris coronata* the scrobicular circles of the upper tubercular plates are separated by a considerable granulated space, whereas in *Cidaris Bouchardii* the scrobicular circles are contiguous ; the granules of the scrobicular circles are likewise larger and more spaced out in *Cidaris coronata* than in *Cidaris Bouchardii*, and the primary tubercles are proportionately larger in the former. Although both urchins have zigzag depressions down the centre of the inter-ambulacral areas, in *Cidaris coronata* the miliary zone is much wider, and covered with larger granules. The poriferous zones are sunk in very deep depressions in *Cidaris coronata*, arising from the prominence of the granules on the ambulacral and inter-ambulacral areas, but these zonal depressions are not so deep in our species.

Cidaris Bouchardii resembles *Cidaris propinqua*, Münster, only in the depressed form of the test. In all other points it is sufficiently distinct from that species. In *Cidaris propinqua* there are four primary tubercles in each column of tubercular plates ; and those on the upper surface are very large in proportion to the size of the test ; their areolas have entire scrobicular circles of large spaced-out granules, which are closely contiguous ; the ambulacral areas are much flexed, and have two rows of close-set marginal granules ; the poriferous zones are slightly sunk, and have very small holes. The spines of *Cidaris propinqua* have an elliptical-shaped body, covered with longitudinal rows of small tubercles, and united together by connecting calcareous threads.

Cidaris Bouchardii resembles *Cidaris marginata*, Goldf., in the depressed form of the test, and in having, like it, deep sunk areolas, with a wide, depressed, much granulated miliary zone, between the primary tubercles ; but it is distinguished from *Cidaris marginata* in having narrower ambulacral areas, with only two rows of granules ; whilst *Cidaris marginata* has four rows throughout. The primary tubercles are likewise smaller, and their bosses are sharply crenulated ; whilst in *Cidaris marginata* they are smooth and uncrenulated. This magnificent Coral Rag German urchin is, moreover, a much larger form than our species from the Inferior Oolite.

Locality and Stratigraphical position.—This is a very rare urchin, and was discovered by us about three years ago in the Pea Grit of the Inferior Oolite of Birdlip and Crickley Hills. Since Pl. I was finished, we have obtained the finest specimen yet known, which presents many points of importance that are not shown in our earlier found specimens. This urchin is figured in Pl. VIII, fig. 3 *a, b, c*. We collected, with Dr. Syme, *Cidaris Bouchardii* in the Inferior Oolite near Bridport, Dorsetshire, in beds which are equivalent to the Upper Ragstones of the Inferior Oolite of Gloucestershire. The Dorsetshire specimens were associated with *Collyrites ringens*, *Collyrites bicordatus*, and *Clypeus altus*, being

all species belonging to that zone of the Inferior Oolite which contains *Ammonites Parkinsoni*, Sow., and *Ammonites subradiatus*, Sow. Some separate plates of an urchin collected with spines from the Bradford Clay, near Tetbury-road Station, Great Western Railway (Pl. V, fig. 7 *a, b*), closely resemble this form; but no entire test of this *Cidaris* has been found, and it is doubtful whether or not it is distinct from *Cidaris Bouchardii*.

We dedicate this urchin to our friend M. Bouchard Chantereaux, of Boulogne-sur-Mer, to whom we are indebted for some beautiful and rare Jurassic Echinoderms and other fossils, sent by him in the kindest manner to aid us in the production of this Monograph.

CIDARIS WRIGHTII, Desor. Pl. I, fig. 3 *a, b, c, d, e, f*.

CIDARIS PROPINQUA. Wright, Annals and Magazine of Natural History, 2d series, vol. viii, p. 250, pl. 11, fig. 6.

— WRIGHTII. Desor's Synopsis des Echinides Fossiles, p. 7.

Test thick, circular, inflated, not much depressed at the poles; ambulacral areas very narrow, sinuous, and furnished with two rows of close-set marginal granules throughout; the inter-ambulacral areas have six tubercles in each column of plates; the tubercles are large, and slightly perforated; the upper mammillary bosses only are crenulated; the areolas are surrounded by complete scrobicular circles of small, prominent, well-spaced-out granules; apical disc unknown; spines never found attached to the test.

Dimensions.—Height, six tenths of an inch; transverse diameter, 1 inch.

Description.—When this urchin was found, five years ago, we were then unable to compare it with a type specimen of *Cidaris propinqua*, Münster. A subsequent comparison with the German species has convinced us that we were mistaken in our determination, and it has long lain marked as a new species in the trays of our cabinet. M. Desor, in his 'Synopsis des Echinides Fossiles,' has likewise detected the difference between this species and *Cidaris propinqua*, and justly observes—"Petite espèce voisine du *Cid. propinqua*, mais plus renflée; les tubercules paraissent aussi être moins gros. Ambulacres très étroits, composés de deux rangées seulement de granules."* This rectification removes another of those apparent exceptions to the law which regulates the distribution of species in time and space, for it is now evident that no species of Echinoderm is common to the Inferior Oolite and Coral Rag of England; but, on the contrary, that both these formations are characterised by distinct and well-defined species of this class.

The test of *Cidaris Wrightii* is very thick for so small a species. It is inflated at the

* 'Synopsis des Echinides Fossiles,' p. 7.

sides, and not much depressed at the poles (Pl. I, fig. 3 *a, b*); the ambulacral areas are very narrow and sinuous, having two rows of small, equal-sized, close-set granules arranged on the margins thereof; the poriferous zones are rather deeply sunk, from the prominence of the ambulacral granules, and those of the scrobicular circles, which extend to the zones; the pores are round, and the septa between the pores are about the thickness of the diameter of one of the holes: there are thirteen pairs of pores opposite one inter-ambulacral plate. (Pl. I, fig. 3 *c*.)

The inter-ambulacral areas, at the equator, are five times the width of the ambulacral; each tubercular column consists of six plates, which support very large, prominent tubercles; the areolas are circular, and surrounded by a complete scrobicular circle of prominent, well-spaced-out granules (fig. 3 *c*); the mammillary bosses are small; the summits of the three inferior mammæ are smooth and destitute of crenulations, those of the two or three upper ones are feebly crenulated; the tubercles are disproportionately large to the size of the bosses, and even of the test itself; they are hemispherical eminences terminating a stout stem, and all their perforations are in the form of oblong slits; the size and prominence of the tubercles form an excellent diagnostic character for this species; the scrobicular circle consists of fourteen small, round, prominent granules, raised on little basal eminences, and forming a distinct beaded wreath around each areola (fig. 3 *c*).

The miliary zone, between the two rows of tubercles, is slightly concave; it does not extend throughout to the apical disc, in consequence of the large upper tubercles encroaching on each other; in its widest part it is filled with three rows of granules, much smaller in size than those forming the scrobicular circle.

The mouth opening is circular, about one half the diameter of the test at the equator; the primary tubercles near the peristome are well developed, and very prominent; they increase gradually in size towards the upper surface; the opening for the apical disc is of moderate dimensions.

The spines which are referred to this species (Pl. I, fig. 3 *d, e*) belong to the same group as that to which *Cidaris florigemma* belongs. They are from an inch and a quarter to an inch and a half in length; the stem swells gently outwards towards its inferior third, and then tapers to the extremity; it is covered with longitudinal rows of granules, united together by lines of calcareous threads (fig. 3 *f*), which shows the surface of the spine enlarged several diameters. As these spines have not been found attached to the test, it is only the smoothness of the acetabulum, and the similarity in size, that gives probability to the supposition that they really belonged to the test to which we have provisionally assigned them. As many grave errors have been committed by assigning spines to tests to which they never belonged, we caution the reader, that unless spines have been found on the test, or *in situ* on the tubercles thereof, we must treat the supposition of their belonging to the same individual as a question of doubt.

Affinities and differences.—*Cidaris Wrightii* resembles *Cidaris propinqua* in the dis-

proportionate size of its tubercles to that of the test, and in having some of the bosses smooth, and others feebly crenulated, but it is distinctly separated from that form by having six plates in the tubercular columns, *Cidaris propinqua* having only five; the test is more globular and inflated, the areolas are smaller, the circles of scrobicular granules are not so prominent, and the tubercles are more crowded together; the spines of *Cidaris Wrightii* are larger in proportion to the diameter of the test than in *Cidaris propinqua*; their stems are smaller, and taper more, and the rows of tubercles are not very prominent; whereas in *Cidaris propinqua* the stems of the spines are thick and elliptical, and the tubercles are large and bead-like on their surface.

Cidaris Wrightii is distinguished from *Cidaris Bouchardii*, with which it is associated in the same bed, by its globular and inflated test, the size of the tubercles, and the shallowness of the areolas; *Cidaris Bouchardii* having a depressed test, with small tubercles, and deeply sunk areolas.

From *Cidaris Fowleri* this species is distinguished by the size and prominence of the tubercles, the narrowness of the ambulacral areas and poriferous zones, and the greater proportionate height and inflation of the test; the ambulacral areas in *Cidaris Fowleri* are broad, with four rows of small granules; and the pores in the poriferous zones are wide apart. The spines in these two associated species are likewise very different; those of *Cidaris Fowleri* are oval, and covered with irregular rows of small spines; whilst those of *Cidaris Wrightii* have regular longitudinal rows of small tubercles.

Cidaris Wrightii has many points of affinity with *Cidaris florigemma*, both as regards the general structure of its test and the form and decoration of its spines; but it is distinguished from that Coral Rag form in having larger tubercles and smaller areas, with a much wider granulated miliary zone between the primary tubercles. The spines assigned to *Cidaris Wrightii* belong to the same group as those of *Cidaris florigemma*, but the stem is longer and narrower, and the granules forming the rows are set closer together, and not so prominent as in *Cidaris florigemma*, where they form lines of tubercles very distinct from each other. Although connected by delicate calcareous threads, the apices of the tubercles are likewise directed forwards, and the summit of the stem terminates in a truncated star-like extremity. (Pl. I, fig. 3 e.)

Locality and Stratigraphical position.—This is a very rare Cidarite. Three specimens only have been found by me in the Pea Grit of Crickley Hill, which are all more or less imperfect; and I have never seen an example in any other cabinet. An urchin found in the Stonefield Slate at Eyeford, Gloucestershire, is referred to *Cidaris propinqua*. Whether this is identical with *Cidaris Wrightii* I have no means of judging, not having seen the type specimen catalogued under that name.

History.—It was first figured in my ‘Memoir on the Cidaridæ of the Oolites,’ and subsequently entered in M. Desor’s ‘Synopsis des Echinides’ under the name it now bears.

CIDARIS CONFLUENS, *Forbes*, MS.

CIDARIS CONFLUENS. Morris, Catalogue of British Fossils, 2d edition, p. 74.

— — Woodward, Memoirs of the Geological Survey, Decade V, Note on species of *Cidaris*.

The specimen consists of four consecutive plates, of nearly equal size, from one of the inter-ambulacral rows. The set measures one inch in length and half an inch in width. The areolas are oblong and excavated, with acute lateral margins, but they are all confluent above and below; the bosses have broad, prominent, deeply crenulated summits; the tubercles are small, and widely perforated; the lateral borders of the plates supported small granulations. The spines imbedded in the same rock were long, cylindrical, and longitudinally striated; their surface was armed, at intervals, with short, stout, forward-directed prickles. The ambulacral areas are absent; and the surface of the plates is so much weathered, that I did not consider it necessary to figure the specimen.

This fragment resembles very much *Cidaris Lorieri*, Wright, from the étage Bajocien, or Inferior Oolite, of the department of the Sarthe (a description of which will be found in the notes of foreign species of the genus *Cidaris*), but the weathered and fractured condition of the fragment renders it impossible to make a more correct diagnosis until better specimens are found.

Locality and Stratigraphical position.—The specimen belongs to the Museum of Practical Geology, Jermyn Street; and was obtained from the Inferior Oolite, near Frome, Somersetshire.

C. *Species from the Bradford Clay.*CIDARIS BRADFORDENSIS, *Wright*. Pl. V, fig. 7 *a, b, c, d.*

Form and size unknown; ambulacral areas narrow, with two rows of marginal granules; inter-ambulacral plates thick, areola circular, boss prominent, summit feebly crenulated, tubercle large; a complete scrobicular circle of fifteen large granules around the areola; miliary zone concave, with six to eight rows of granules; the spines, associated with the plates, have the acetabulum small, the neck long and smooth; the stem elliptical, and covered with waved lines of granules, neither uniform in size nor arrangement.

Description.—The meagre materials at my disposal, illustrative of this urchin, only permit me to give a very imperfect diagnosis of this Oolitic form, which I at one time

thought was identical with *Cidaris Bouchardii*; but on making a careful examination of the ambulacral and the inter-ambulacral plates, the only portions of the test I have seen with those of that species, I am inclined to think them distinct. The plates are thick and deep (Pl. V, fig. 7 *a, b*); the areolas are circular, with a complete circle of scrobicular granules around them; the bosses are raised a little way above the margin of the areola, and the summits are feebly crenulated; the tubercle is large, and supported on a short stem; the miliary zone is wide and concave, and there are six or eight rows of coarse granules filling up the same. The ambulacral areas are narrow, with two rows of marginal granules, one granule being opposite each pair of holes; the poriferous zones are narrow, the holes are round, and the septum has a tubercle developed on its surface; there are seventeen pairs of holes opposite one large tubercular plate. The spines, associated with the plates in the same bed, are well preserved (Pl. V, fig. 7 *d, e*); the acetabulum and head are small; the neck is long and smooth; and the stem is covered with granules, which are arranged in lines that are not longitudinal, but slightly waved. Most of the fragments appear to have been drifted; they are more or less covered with a species of small serpula, which seems to have been abundant in the seas of that period.

Affinities and differences.—This species very much resembles *Cidaris Bouchardii*, but its tubercles are proportionately larger, and the areolas are smaller; the scrobicular circle of granules is more defined, the miliary zone contains a greater number of granules, and there is a granular space between some of the scrobicular circles which does not exist in *Cidaris Bouchardii*.

Locality and Stratigraphical position.—The plates and spines of this species have been collected from the Bradford Clay, near the Tetbury-road Station of the Great Western Railway, associated with *Rhynchonella concinna*, Sow., *Terebratula cardium*, Lamarck, *Terebratula digona*, Sow., and other Bradford Clay forms.

D. Species from the Coralline Oolite.

CIDARIS FLORIGEMMA, *Phillips*. Pl. II, fig. 2 *a, b, c, d, e, f*; Pl. VIII, fig. 4 *a, b, c, d*.

- "LAPIDES JUDAICI OF OXFORDSHIRE." Plott, Natural History of Oxfordshire, pl. 6, figs. 8, 9, spines only, p. 125, 1677.
- "RADIOLUS ECHINITE MAXIMI LATICLAVII." Lhwydd (Luidius), Lithophylacii Brittanici Ichnographia, editio Altera Oxonii, 1760, t. 12, fig. 1002, p. 49.
- DIE NATURGESCHICHTE DER VERSTEINERUNGEN, KNORR II, i, t. E, figs. 4, 5; t. E, vi, fig. 9, 1768.
- "A GLOBOSE MAMMILLATED ECHINITE FROM OXFORDSHIRE." Parkinson, Organic Remains, pl. 1, fig. 9, and pl. 4, figs. 15 and 17, vol. iii, p. 13, 1811.
- CIDARITES BLUMENBACHII. Goldfuss, Petrefacta Germaniæ, p. 117, t. 39, fig. 3 *c, d, e* (aculei non testa), 1820.
- CIDARIS FLORIGEMMA. Phillips, Geology of Yorkshire, pl. 3, figs. 12 and 13, p. 127, 1829.
- — De la Beche, Geological Manual, 3d edition, p. 535, 1833.
- CIDARITES ELONGATUS. Roemer, Die Versteinerungen des Norddeutschen Oolithen-Giberges, pl. 1, fig. 14, p. 27, 1836.
- FLORIGEMMA. Desmoulins, Etudes sur les Echinides, p. 338, No. 31, 1837.
- — Agassiz, Prodromus Echinoderm., No. 31.
- CIDARIS BLUMENBACHII. *Id.* Echinodermes Fossiles Suisse, part ii, t. 20, figs. 5, 6 (non fig. 7), p. 56, 1840.
- CIDARITES BLUMENBACHII. *Id.* Catalogus systematicus ectyporum Echinodermatum Fossilum, p. 10, 1840.
- CIDARITES BLUMENBACHII. Lamarck, Histoire Naturelle des Animaux sans Vertèbres, 2d edition, tome iii, p. 386, 1840.
- CIDARIS BLUMENBACHII. Morris, Catalogue of British Fossils, p. 49, 1st edit., 1843.
- — Wright, Annals and Magazine of Natural History, 2d series, vol. viii, p. 248.
- — Bronn, Lethæa Geognostica, 2d edition, p. 140, 1851.
- — Cotteau, Etudes sur les Echinides Fossiles du département de l'Yonne, pl. 10, figs. 7, 8 (non fig. 6), p. 108, 1852.
- — Desor, Synopsis des Echinides Fossiles, t. 3, fig. 14, p. 5, 1854.
- FLORIGEMMA. Morris, Catalogue of British Fossils, p. 74, 1854.
- — Woodward, Memoirs of the Geological Survey, Decade V, Notes to Cidaris.

Test round, much inflated at the sides, and depressed at both poles; ambulacral areas narrow, elevated, and sinuous, with two marginal rows of granules set on basal eminences, and in the widest part of the area, two other rows of very small granules, without basal eminences, the middle rows disappear at both ends of the areas: inter-ambulacral areas wide, with two rows of primary tubercles, from six to seven in each column; areolas rather oblong, and surrounded by a prominent elevated scrobicular circle of well-spaced-out granules, set on shield-like bases; miliary zone wide, concave, and filled with several rows

of small granules; mouth opening small, peristome pentagonal; apical disc opening large and pentagonal; primary spines with large, thick, cylindrical stems, ornamented with longitudinal rows of prominent, forward-directed granules; secondary spines short and spatulate, covered with fine longitudinal lines; tertiary spines small, conical, or oval shaped.

Dimensions.—A. Large specimen: Equatorial diameter, two inches and four tenths of an inch; height, one inch and seven twentieths of an inch.

B. Large specimen: Equatorial diameter, two inches and two tenths of an inch; height, one inch and four tenths of an inch.

C. Usual-sized specimen: Equatorial diameter, one inch and four tenths of an inch; height, one inch and four tenths of an inch.

Description.—This noble urchin was very abundant in the Corallian Seas of Europe, and its test and spines form characteristic fossils of this stage of the Jurassic group. Much confusion regarding this species has been caused by Goldfuss having figured, along with the test of *Cidaris Blumenbachii*, Münster, the spines of three or four other species of urchins, and especially in having erroneously described the spines of *Cidaris florigemma* as belonging to the test of *Cidaris Blumenbachii*. I am indebted to my friend Mr. S. P. Woodward for having called my attention to this subject, as he has always maintained that *Cidaris florigemma*, Phil., was distinct from *Cidaris Blumenbachii*, Goldf. Having been fortunate in finding the slab, figured in Pl. II, fig. 2 *a*, containing a small *Cidaris florigemma* with spines attached, I had direct evidence that the spines figured by Goldfuss as those of *Cidaris Blumenbachii* in reality belonged to the Wiltshire urchin. The next point to be ascertained was, whether the test figured by Goldfuss was different from the test of this species. A critical examination and comparison of good type specimens of *Cidaris Blumenbachii*, one in the collection of the British Museum, and another kindly sent me by Dr. Fraas, of Stuttgart, with the specimen figured in Pl. II, fig. 2 *b, c*, has proved that they are very distinct from each other.

Plott, in 1677, figured the spines of this urchin under the name of *Lapides Judaici*. He says—"We find them here (Oxfordshire) of different sizes, from about two inches in length and an inch and a half in circuit, downwards to an inch and less in length and not much above half an inch round. Most of them have a pedicle from which they seem to have had their growth, and are ridged and channelled the whole length of the stone, the ridges being parted with small knots set in quincunx order. As to their texture, I find it to be very curious, made up of lamellæ or little thin plates, not unlike the stone *Selenites*; only these are opaque, and the whole bulk of the stone indeed much different. The plates, as in the *Selenites*, seem to be made up of strings, which in most of them run

three, but in some but two ways: according to the running of these strings the stones will easily cleave, but generally some one way rather than any other, which most commonly is agreeable to the helical running of the ridges of knots or furrows between them, yet always obliquely to the axis of the stone, as is perfectly shown, tab. vi, fig. 9, which represents the stone broken three several ways.”*

Lhwydd, in 1690, figured spines of the same species from the Coral Rag of Oxfordshire. Parkinson, in his ‘Organic Remains of a Former World,’ gave a beautiful figure of the test (Pl. I, fig. 9), which, it is but just to state, has been entirely overlooked, the references to his work having been made only to the figures of the spines (Pl. IV, figs. 15, 17); the first good figure of the test of this species therefore is, in reality, that of Parkinson’s. In the ‘Petrefacta Germaniæ,’ Goldfuss gave good figures of the spines which he stated appertained to the test of *Cidaris Blumenbachii*; and subsequent palæontologists, believing his statement, have nearly all followed his error. In the ‘Description des Echinodermes Fossiles de la Suisse,’ M. Agassiz has figured the spines of *Cidaris florigemma* with the test of *Cidaris Blumenbachii*; this is shown in the figure by the smallness of the granules of the scrobicular circle, in the smallness of the tubercles, and the depth of the crenulations on the summits of the bosses, a group of characters which belong to *Cidaris Blumenbachii*. In the ‘Geology of Yorkshire,’ Professor John Phillips figured a test and spine of this species, under the name *Cidaris florigemma*, from a Wiltshire specimen now in the Museum of the Yorkshire Philosophical Institution; the correctness of the determination then made has been proved by the tedious investigation which was necessary to clear away the existing confusion relative to this species. M. Desor, in his ‘Synopsis des Echinides Fossiles,’ restricts the name *Cidaris Blumenbachii* to the spines, “aculei non testa,” figured by Goldfuss; but I cannot agree with my friend in this conclusion, because Münster gave the name to *the test*, about which there can be no mistake. Goldfuss’s error consisted in describing and figuring spines as belonging to this test which appertained to another species; therefore I say “testa non aculei” in the synonym: as the test is the body of the animal, and the spines are merely appendages of the same, it follows that the name given by an author to a species must in every case relate to the major, and not to the minor part described. Münster’s name, therefore, must still be given to the German form; which, as far as is at present known, has not yet been found in England. M. Desor observes: “J’ai été fort longtemps dans le doute sur les limites de cette espèce, par la raison que les radioles et le test que Goldfuss a réunis, n’appartiennent pas au même oursin. C’est tout récemment que la découverte de quelques échantillons avec leurs radioles attachés au test, m’a permis de rectifier l’erreur dans laquelle j’étais tombé avec d’autres paléontologistes. Le test figuré par Goldfuss n’a rien de commun avec les radioles qu’il lui attribue; il appartient à une autre espèce décrite ultérieurement par M. Agassiz sous le nom de *C. Parandieri*. Or, comme les radioles sont bien plus abondants

* Plott’s ‘Natural History of Oxfordshire,’ p. 125.

que les tests et qu'ils sont connus de tous les paléontologistes c'est à eux, et partant au test décrit ci-dessus, que je crois devoir conserver le nom primitif de *Cidaris Blumenbachii*."*

The test of *Cidaris florigemma* is round, and much inflated at the sides; it is moderately depressed at both poles, but is most so on the upper surface; the ambulacral areas are narrow, and nearly of a uniform breadth throughout; they are very sinuous and prominent, and are furnished with two rows of granules on the margins of the areas; between these, for about the length of two of the large tubercular plates, there are two rows of very small granules internal to the marginal ones (Pl. II, fig. 2 *g*); the marginal granules are raised on small basal eminences, but the internal granules are not; the six or eight marginal pairs nearest the peristome are very much larger than those in the middle and upper parts of the areas: the poriferous zones are of moderate width; the pores forming a pair are separated from each other by a septum equal in width to the diameter of a pore (fig. 2 *g*); there are nineteen or twenty pairs of pores opposite each of the large equatorial tubercular plates; the zones are rather deep, from the prominence of the ambulacral areas in the middle, and that of the scrobicular circles external to them.

The inter-ambulacral areas are nearly five times the width of the ambulacral areas and poriferous zones; the plates of the tubercular columns are deep, there being only from six to seven plates in each column; the areolas are large and circular, especially above, but they incline towards an oval from below; their margins are surrounded by a prominent scrobicular circle of fifteen or sixteen well-spaced-out granules (fig. 2 *g*), each of which is raised on an oval, shield-like base. In consequence of the size of the areolas in the upper part of the areas, the scrobicular circles of the two uppermost pairs closely approximate; but from this point to the peristome there is a considerable inter-tubercular space, which is filled up with miliary granules of different sizes; those nearest the areolas are raised on small basal elevations, which alternate with those of the scrobicular circle, and the rows internal to them diminish in size as they approach the median sutural line, where they become quite miliary: the mammillary bosses rise from a wide base (fig. 2 *g*); the three or four lower pairs have smooth summits, and the two or three upper pairs only are crenulated; the crenulations, however, are by no means either deeply sculptured, or very persistent in different specimens; the tubercles are large, and are raised on a slightly contracted neck; the perforation in the hemispherical head has the form of an oblong slit, which passes through the head, and extends to the summit of the boss.

The mouth opening is large, and the peristome has a pentagonal form (fig. 2 *b*). In specimen B, it measures nine tenths of an inch in diameter, that of the equatorial diameter being two inches and two tenths; the primary tubercles in the vicinity of the peristome are large and well developed, although smaller than those on the sides and upper surface of the test; the minute tubercles at the base of the ambulacral areas are only a little larger than the marginal granules of these areas.

* 'Synopsis des Echinides Fossiles,' p. 5.

The apical disc is absent in all the specimens I have examined. It was of considerable size; the diameter of the opening in specimen B being $\frac{1}{20}$ ths of an inch.

The spines are of three kinds, the primary, the secondary, and the tertiary. (Pl. II, fig. 2 *d, e, f*.) The primary spines or radioles are very elegant bodies, and as they are often preserved in the Corallian stage, when the test to which they belonged is not discovered, a knowledge of them is of stratigraphical importance to the student of the Jurassic rocks. The concave articulating cavity has a deep pit in its centre (fig. 2 *e*) for the insertion of a ligament, and the rim of this acetabulum is surrounded with a circle of moniliform crenulations; the head is small, and is surrounded by a narrow ring, nearly smooth, and covered only with a microscopic milling of longitudinal lines; the ring is midway between the rim of the acetabulum and the point where the head articulates with the neck (fig. 2 *e*); the neck is short, and is covered with fine longitudinal lines; it soon expands to form the body of the spine, the thickest part of which is just beyond the neck, from whence the stem gradually tapers to the apex, which is always more or less truncated (fig. 2 *d*); the stem is covered with small granulations, very uniform in size, and regularly disposed in longitudinal rows, forming from twenty to thirty lines of tubercles on the body of each spine, the number of the rows varying in different spines; the tubercles of the adjoining rows alternate, so as to produce a quincuncial arrangement; and the tubercles of each series are connected together by a calcareous filament which passes from one tubercle to another; the tubercles are all inclined towards the apex of the spine, and many of them terminate in short, prickly processes, which have their points directed forwards; the surface of the spine between the rows of granules is covered with numerous longitudinal lines: at the summit of the spines the granules coalesce, forming so many plates, which expand, and produce a radiated or star-like disc at the truncated extremity thereof. Some of the spines attain the length of two inches and three quarters. The secondary and tertiary spines are short and spatulate (fig. 2 *f*), and their surface is covered with fine longitudinal lines.

Affinities and differences.—In the form and structure of the test in general, *Cidaris florigemma* resembles *Cidaris Blumenbachii*, *marginata*, *coronata*, and *monilifera*, but it is distinguished from all these forms by its greater height, and a consequent increase in the number of plates in the tubercular columns; *Cidaris marginata*, *coronata*, and *monilifera* having five plates in each column, whilst *Cidaris florigemma* has from six to seven. In the plates on the upper part of the test of these species, the miliary zone is much wider, and the circles of areolar granules are likewise separated by many rows of miliary granules, which are altogether wanting in *Cidaris florigemma*. The ambulacral areas in *Cidaris marginata*, *coronata*, and *monilifera* have four distinct rows of small, nearly equal-sized granules, whilst in *Cidaris florigemma* the two marginal rows alone are well developed throughout.

Cidaris florigemma is distinguished from *Cidaris Fowleri* by the narrowness of its ambulacral areas, and by the size and prominence of the marginal granules; the

poriferous zones are likewise very much narrower, and the pores are smaller and set closer together; the inter-ambulacral areas are wider, whilst the miliary zone is narrower; the scrobicular circles are likewise much more prominent, and have larger granules, raised on distinct eminences; the smooth summits of the mammillary bosses of the lower tubercles, and the faint crenulations on those of the upper ones, form a striking contrast to the broad, deeply crenulated summits of the mammillary bosses in *Cidaris Fowleri*.

The same group of characters which serve to distinguish *Cidaris florigemma* from *Cidaris Fowleri* form the diagnosis between it and *Cidaris Orbignyana*.

Cidaris florigemma resembles *Cidaris Smithii*, Wright, with which it is occasionally associated in the same rock in Wiltshire and Yorkshire, in the general form and height of the test, but it is distinguished from this much rarer species by having fewer tubercles in the inter-ambulacral areas, and much more prominent scrobicular circles around them; *Cidaris Smithii* having ten primary tubercles in each column, and the granules of the scrobicular circles not being much larger than those filling the miliary zone; the ambulacral areas are likewise narrower, and the poriferous avenues are narrower and deeper; the spines, likewise, are longer, narrower, and differently sculptured.

The primary spines of *Cidaris florigemma* most nearly resemble those of *Cidaris coronata*, but their length, and the regularity of their rows of granules, serve to distinguish them from those of that species. The only other species of *Cidaris* with which it is necessary to compare them, is that of *Cidaris Smithii*, which sometimes occurs with *Cidaris florigemma* in the same rock in England. Although the tests of these two species resemble each other when of the same size, still the spines show that they belong to two distinct groups of urchins, the stems of *Cidaris florigemma* being thick and massive, whilst those of *Cidaris Smithii* are long and slender, tapering very gradually from neck to point; the surface is covered with elevated longitudinal ridges, covered with sharp, forward-directed prickles; these spines are sometimes nearly twice the length of those of *Cidaris florigemma*. (Pl. V, fig. 5.) The test of *Cidaris Blumenbachii* has the areolas deeply excavated; the bosses not very prominent, the summits all sharply crenulated, and the tubercles small; the granules forming the scrobicular circle are not larger than those of the small granulation filling the miliary zone. These characters are so completely diagnostic, that it is impossible to mistake the true German form for *Cidaris florigemma*, when the two urchins are placed side by side for comparison. If to these characters of the test, however, are added those obtained from the spines, we learn how entirely distinct *Cidaris Blumenbachii* is from *Cidaris florigemma*.

Locality and Stratigraphical position.—*Cidaris florigemma* is found in fine preservation in the Coralline Oolite of Wiltshire, Berkshire, Oxfordshire, Yorkshire, and Dorsetshire. The specimens figured in Pl. II were collected near Calne, in Wilts; and I have seen a beautiful specimen found in that formation at Hildenly, near Malton, Yorkshire.

Judging from the spines figured by Goldfuss, Agassiz, Roemer, and Cotteau, this species must have had a wide European area of distribution, as its test or spines have been collected in the Coral Rag of different parts of Germany, Switzerland, and France.

History.—The history of this species has been given with so much detail in the introductory remarks, that it is unnecessary to reproduce the facts under this section.

CIDARIS SMITHII, *Wright*, nov. sp. Pl. II, fig. 1 *a, b, c, d, e*; Pl. V, fig. 5 *a, b, c, d, e*.

Test large, much inflated at the sides, and depressed at the poles; ambulacral areas flat, with two marginal rows of small granules, and two inner rows of microscopic granulations; poriferous zones wide, the pores separated by very thick septa; inter-ambulacral areas with ten primary tubercles in each row; areolas oval, and deeply sunk; scrobicular granules not larger than the miliary granules; miliary zone wide and concave, and filled with six or eight rows of nearly equal-sized miliary granulations; mouth opening wide, peristome pentagonal, jaws and teeth large and powerful; primary spines long, slender, and tapering; surface of the stem with thick longitudinal ridges, from which stout forward-directed processes proceed.

Dimensions.—Height, one inch and eight tenths of an inch; transverse diameter, two inches and three fourths of an inch.

Description.—This noble urchin is a much rarer form than the preceding species, with which, however, it is sometimes associated in the same beds of the Coralline Oolite in Wiltshire and Yorkshire. As a distinct species, it has hitherto escaped the notice of palæontologists.

The test is large, much inflated at the sides (Pl. II, fig. 1 *b*), and depressed at both poles; the ambulacral areas are slightly elevated, of moderate width, and gently undulated; they are widest at the equator, and diminish above and below; they have two marginal rows of small granules, which are alternately larger and smaller (fig. 1 *c*); sometimes two of the smaller granules are interposed between every two of the larger ones; within these marginal rows are two rows of close-set, equal-sized, microscopic granules, which disappear at the upper and lower parts of the areas.

The poriferous zones are very superficial, and are nearly as wide as the areas; the pores are separated by thick septa, and the pairs of pores are directed obliquely upwards; the holes of the inner row are round, whilst those of the outer row are oblong or pyriform; the septa are slightly scooped out on their margins above and below, so that each pair of pores, with its intervening partition, somewhat resembles the frame of a pair of spectacles,

with a straight bridge (fig. 1 *c*) ; the bevelled margins of the septa produce an appearance like a third row of blind holes in the centre of the zone ; there are from thirteen to fourteen pairs of pores opposite one of the large tubercular plates.

The inter-ambulacral areas have a greater number of tubercular plates than is found in any other Oolitic species ; in each column there are ten plates, the primary tubercles of which are proportionately small ; the areolas are oblong, and are rather deeply sunk, with sharp, prominent margins ; the granules forming the scrobicular circle are not larger than those filling the miliary zone ; the bosses are not very prominent, and are only a little higher than the rim of the areolas ; their summits are flat, and sculptured with fourteen deep crenulations (fig. 1 *d*) ; the tubercles are small in proportion to the dimensions of the test, and are very uniform in size throughout the area ; the areolas on the upper part of the areas are nearly circular, those at the under part are oblong ; only the upper five areolas have complete circles of granules round their margins ; and the three or four lower areolas are separated by a transverse ridge of the test, on which no granules are developed.

The miliary zone is broad and concave, and is filled with eight or nine rows of small granules, set on eminences, around the bases of which circles of microscopic granules are very regularly disposed ; between the poriferous zone and the adjoining row of tubercles, there is a miliary zone filled with three or four rows of granules.

The mouth opening is large (fig. 1 *a*) ; the peristome is pentagonal, but its figure cannot be accurately described, as several of the plates are fractured ; the lantern is large, and was composed of five powerful jaws, which remain with their teeth *in situ*. In the fine specimen communicated by my friend, the Rev. P. B. Brodie, and figured in fig. 1 *a*, each jaw consists of a broad central portion and two lateral carinæ ; the long, curved, conical, triangular teeth are bevelled into a chisel-like form on the inner surface, and project five twentieths of an inch beyond the alveoli.

The spines are long, slender, and tapering (Pl. II, fig. 1 *e*, and Pl. V, fig. 5 *a, b, c, d, e*) ; the head is short, with a slightly prominent milled ring (fig. 5 *c*) ; the acetabulum is sharply crenulated (fig. 5 *d*) ; the neck is marked with fine longitudinal lines (fig. 5 *c*) ; the stem is round or oval (fig. 5 *e*), and is covered with eight or nine prominent longitudinal ridges, which have short, stout, oblique, forward-directed prickles developed from their surface (fig. 5 *a, c*) ; a fragment of the stem (fig. 5 *a*) is nearly three inches in length.

Affinities and differences.—This species very much resembles *Cidaris Blumenbachii*, Münster, in the general structure of the test, but it is distinguished from that species by the following characters : In *Cidaris Blumenbachii* the poriferous zones are narrow, and the pores are all round ; the inter-ambulacra have only from six to seven tubercles in each row, and the areolas are sunk and circular. In *Cidaris Smithii* the poriferous zones are wide ; of each pair of pores, the one is round, and the other is oval ; the inter-ambulacra have ten tubercles in each row, and the areolas of the inferior tubercles are oval. Both

forms have wide miliary zones, but those of *Cidaris Smithii* are the widest; the granules of the scrobicular circle in both are not larger than those of the miliary zone, and both have deeply sunk areolas.

A comparison of figs. 1 and 2, in Pl. II, will show in what *Cidaris Smithii* differs from *Cidaris florigemma*. The latter has circular areolas, with a well-developed scrobicular circle of large granules (fig. 2 *g*); narrow poriferous zones; large tubercles, with smooth bosses, and seven tubercles in each row. The spines of *Cidaris florigemma* (Pl. II, fig. 2 *d*) have a thick, clavate stem, with longitudinal rows of moniliform murications; whilst those of *Cidaris Smithii* are long, slender, and tapering, with longitudinal elevations carrying forward-directed processes.

Cidaris Smithii resembles *Cidaris maxima*, Münster, in the general structure of both areas, but the former has more tubercles in each row in the inter-ambulacral areas than the latter species. The spines of *Cidaris Smithii* have a more regular arrangement of the longitudinal elevations and processes thereon; the stem likewise tapers gently from the neck to the apex, and wants the central swelling and irregular forward-directed prickles which characterise the spines of *Cidaris maxima*.

Locality and Stratigraphical position.—This species was collected long ago, from the Coral Rag of Hillmarston, Wiltshire, by the late Dr. William Smith, the father of English palæontology. The original specimens are now in the British Museum. Mr. Lowe collected it from the Coral Rag of Calne, Wilts. Dr. Murray, of Scarborough, found a beautiful specimen in the Coralline Oolite of Ayton, near Scarborough, which is now in his cabinet. The Rev. W. F. Wits collected some plates and spines in the Upper Calcareous Grit near Scarborough Castle. Mr. William Buy has found two or three very perfect specimens in the Coral Rag near Calne; and Mr. Gibbs has collected plates and spines from the same formation in other localities in Wiltshire.

This species, therefore, characterises the Coralline Oolites of England, and belongs to the same horizon as *Cidaris florigemma*, *Diadema pseudo-diadema*, *Diadema versipora*, with which it is associated in the same rock.

History.—This species has, by some, been mistaken for *Cidaris florigemma*; and, by others, has been considered to be the true *Cidaris Blumenbachii*. The zootomical details into which I have entered show that it is very distinct from both.

It is now figured and described for the first time. I dedicate this fine species to the memory of our distinguished countryman, Dr. William Smith, whose accurate observations, large views, and many researches conducted in a true philosophical spirit, led to the discovery of that great stratigraphical law, that each of the different strata of the earth's crust contains its own specific forms of organic life.

E. *Species from the Kimmeridge Clay.*[*Spines of which the test is unknown.*]CIDARIS SPINOSA, *Agassiz*. Pl. XII, fig. 4.CIDARIS SPINOSA. Agassiz, *Echinodermes Fossiles de la Suisse*, part ii, p. 71, pl. 21, fig. *a*.— — Desor, *Synopsis des Echinides Fossiles*, p. 26, t. 3, fig. 2.— — Morris, *Catalogue of British Fossils*, 2d edit., p. 75.

The principal character of this species consists in the prominent thorny processes which project from the surface of its stem, which is round and slender, and is likewise finely marked with longitudinal lines; the neck is short. It is exceedingly difficult to determine from a single spine, without comparing it with the type, whether that which is figured is identical with the *Cidaris spinosa*, Agass. It certainly comes nearest to that form with which it is provisionally placed. It was collected from the Kimmeridge Clay of Aylesbury.

CIDARIS BOLONIENSIS, *Wright*. Pl. XII, fig. 5.

Spine long, nearly two inches in length; acetabulum deeply crenulated; ring prominent, acutely carinated; neck long, slender, smooth; stem flattened, covered with finely granulated longitudinal ridges, which have prominent, thorn-like, forward-directed processes, developed at irregular intervals on the stem, which is flat and oar-like at its distal extremity. On this blade-like termination there are sometimes prominent, longitudinal carinae, formed by the excessive development of the terminal granulated lines.

Affinities and differences.—This spine resembles that of *Cidaris Orbignyana* in its general characters; but it has a longer neck, a more prominent and acutely carinated ring, and the stem is likewise furnished with stouter thorn-like processes; in the flattened condition of the distal extremity it resembles that species. It is altogether a stronger and larger spine than that referred to *Cidaris spinosa*, and its long, smooth neck serves to distinguish it from that species.

Locality and Stratigraphical position.—Collected by the late Hugh Strickland, Esq., from the Kimmeridge Clay, Dorset. The same species* has been found by M. Bouchard Chantereaux, who kindly sent me a series of spines, from the Kimmeridge Clay near Boulogne-sur-Mer, where it is very rare.

* 'Notes on Foreign Jurassic Species,' page 63.

Genus 2—RABDOCIDARIS, Desor.*

This genus was formed by M. Desor to include all the large inflated Cidarites, which are often as high as they are in transverse diameter; their poriferous zones are likewise wider than in the genus Cidaris, the pores forming a pair are placed wider apart, and connected by a small horizontal sulcus. The ambulacra are straight, or very little flexed. The tubercles are large, and always strongly crenulated, and, in the fossil species at least, proportionately more numerous than in the true Cidaris. The areolas are large, and often elliptical; the miliary zones are wide. The spines are large, and have a long and much developed stem.

The species at present referred to this genus are Oolitic and Neocomian.—Desor.

A. Species from the Lias.

RABDOCIDARIS MORALDINA, Cotteau. Pl. V, fig. 8.

CIDARIS MORALDINA.

Cotteau, Etudes sur les Echinides Fossiles, p. 33, pl. 1, figs. 1—3.

RABDOCIDARIS MORALDINA. Desor, Synopsis des Echinides Fossiles, p. 42.

Test large, form unknown; inter-ambulacral plates large; areola oval, occupying a considerable portion of the plate; mammillary boss with a broad base, not much elevated, summit deeply crenulated; tubercle proportionately small, with a large perforation.

The only specimen I have seen of this urchin is the one figured in Pl. V. It was collected by Mr. Moore from the Marlstone of Somerset. M. Cotteau, who first described the species, founded it upon the imprint of a fragment. Judging from the size of the single inter-ambulacral plate, it must have been a very large Cidarite; the areolas are wide and oval, and, from the space they occupy, they must have been confluent above and below, and surrounded only by incomplete scrobicular circles; the miliary zone was flat and wide. This species has some affinities with *Cidaris maxima*, Münster; but it is distinguished from it by many marked characters: the inter-ambulacral plate is one half larger; the areola is not excavated out of the substance of the plate, as in *Cidaris maxima*, but is level with the surface, and the mammillary boss forms a much larger eminence thereon; the summit is likewise broader and more deeply crenulated.

* ῥαβδοῖς, striated, canaliculated.

Locality and Stratigraphical position.—This fragment was collected from the Marlstone near Ilminster; the specimen figured is all that has ever been found in that locality; the bed in which it was discovered is characterised by the presence of *Ammonites margaritatus*, Montfort. It is interesting to find that M. Cotteau's specimen was collected "dans les couches à *Gryphæa Cymbium* de Vassy près Avallon," where it is very rare: this *Gryphæa* bed corresponds very nearly with the horizon of the Middle Lias in Somersetshire, where the fragment before me was found.

B. *Species from the Great Oolite.*

RABDOCIDARIS MAXIMA, Münster. Pl. XII, fig. 6; Pl. A, fig. 16.

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|---------------------------|---|
| CIDARITES MAXIMUS. | Goldfuss, Petrefact. Germaniæ, p. 16, t. 39, fig. 1 a, b. |
| KNOTTED SPINE OF CIDARIS. | Phillips, Geology of Yorkshire, t. 9, fig. 5. |
| CIDARIS MAXIMA. | Morris, Catalogue of British Fossils, 2d edit., p. 74. |
| RABDOCIDARIS MAXIMA. | Desor, Synopsis des Echinides Fossiles, p. 39. |

The large spine, figured by Professor Phillips, from the Grey Limestone (Great Oolite) of Gristhorpe Bay, Yorkshire, (two of which I collected last summer,) I have identified with a spine kindly sent me by Dr. Oppel, of Stuttgart, from the Inferior Oolite of Neuffen, Württemberg, as typical of Münster's species. A very large and fine specimen of this Great Oolite spine is figured in Pl. A, fig. 16; it measures five inches and a quarter in length. The head is large; the rim of the acetabulum is coarsely and deeply crenulated; the neck is short and smooth; the stem is long and sub-fusiform, nearly five inches in length, it gradually swells out in some specimens towards the middle, and tapers very little towards the distal extremity; the surface is covered with short, stout, thorn-like prickles, with their points slightly directed forwards, which are irregularly developed, at considerable distances apart; they do not form straight lines, but stud the surface in a somewhat spiral order.

None of the plates belonging to this large spine have yet been found in Yorkshire, nor in the Great Oolite of the West of England.

Genus 3—DIPLOCIDARIS, Desor.*

The genus *Diplocidaris* is formed of large urchins, which have all the characters of the true *Cidaris*, but differ from them only in one particular, in having the pores in the zones so arranged as to form double rows, or double oblique pairs, every third pair being vertically above the third pair below them; whereas in the genus *Cidaris* the pores are strictly unigeminal throughout. This important modification in the structure of the poriferous zones has corresponding relations with the number and disposition of the tubular suckers, and probably with the function of respiration. The ambulacral areas are narrow, straight, and flexed, with two rows of small marginal granules; the inter-ambulacral areas are wide; the areolas are round or elliptical, and the bosses have deeply crenulated summits; the tubercles are of moderate size; the miliary zones are very wide, and the surface of the plates is covered with large well-defined granules, set at some distance from each other.

“The spines are short, massive, and cylindrical; their surface is covered with granules, or pustules, instead of spines as in *Rabdoidaris*.”—Desor.

All the species known have been found in the Oolitic rocks.

A. Species from the Upper Lias?

DIPLOCIDARIS DESORI, *Wright*, nov. sp. Pl. VIII, fig. 5.

Test large, form unknown; ambulacral areas narrow and slightly flexed, with two rows of small marginal granules; poriferous zones follow the flexures of the area; the pores round, and contiguous, the septum as thick as the diameter of the pore, with a prominent tubercle on its surface; every two pairs of pores are set obliquely to each other, so that the pores of every third pair stand vertically over each other; inter-ambulacral plates large, rhomboidal, as deep as they are broad; areola large, circular; scrobicular circle complete, abutting against the poriferous zones; granules of the circle of the same size as those covering the rest of the plate; areola shallow, boss not prominent, tubercle small; miliary zone wide, with four or six rows of well-spaced-out granules.

The fragment which I have figured was kindly communicated by my friend, Mr. S. P. Woodward; it was collected near Yeovil, from a rock supposed to be Inferior Oolite.

It is very interesting to find this fragment of a *Diplocidaris* so far down in the Oolitic series, as the specimens of this genus hitherto discovered have all been found in the Coral

* From διπλούς, double.

Rag of Nattheim, Besançon, Châtel-Censoir, and Druyes (Yonne); the only exception to this being a spine (Pl. I, fig. 5) found by me in the Pea Grit, Inferior Oolite, of Crickley Hill, and placed by M. Desor in this genus.

The inter-ambulacral plate is large, as deep as it is wide, and must have formed part of a very large test; the areola is rather more than two thirds of the width of the plate, it is circular, and is placed so near the poriferous zone that its scrobicular circle abuts against the pores. The areola is smooth, superficial, and not excavated; the boss forms an inconsiderable prominence in the centre, and has a broad summit, which was crenulated, although the remains of the markings are now nearly effaced. The tubercle is small in proportion to the size of the plate; the miliary zone must have been very wide, and filled with four or six rows of large granules, which stand at distinct intervals apart. The scrobicular circle is complete; the granules forming it are set upon an elevated rim of the areola, but they are not larger than the other granules covering the surface of the plates.

The ambulacral areas are very narrow and flexuous, having two rows of small granules on their margins; the poriferous zones follow the windings of the area, which are more flexuous in this species than in the German Coral Rag forms, in consequence of the proximity of the scrobicular circle to the zones themselves; in fact, the absence of flexures in *Diplocidaris gigantea* led M. Desor to state that the ambulacra were straight in this genus; whereas they are both straight and flexed, in proportion as the tubercles occupy the middle or the zonal sides of the plates.

The poriferous zones are narrow; the pores are round and contiguous, separated by septa, about as thick as the diameter of the holes; on the surface of the septa the test is elevated, and forms small, blunt granules; the pores are not, strictly speaking, bigeminal, but form an irregular series, every pair being more or less oblique to the pair above them and below them; they may be described as forming double oblique pairs, thus, $\begin{smallmatrix} \cdot & \cdot \\ \cdot & \cdot \end{smallmatrix}$ so that every third pair of holes stand vertically above a third pair below them, a form of arrangement very different from that prevailing in the genus *Cidaris*, in which the pores are strictly unigeminal throughout the entire zones.

Affinities and differences.—*Diplocidaris Desori* differs from *Diplocidaris gigantea* in having deeper rhomboidal plates; and the areolas and tubercles are placed closer to the poriferous zones; the ambulacral areas are likewise narrower; the pores form double oblique pairs in the zones, instead of making two distinct series as in *Diplocidaris gigantea*.

Locality and Stratigraphical position.—This fragment was discovered near Yeovil, in a rock supposed to be Inferior Oolite, but which probably may be Upper Lias. It is impossible to say anything upon this point, unless the Ammonites with which it was associated were before me, inasmuch as the stratigraphical line between the Upper Lias

and Inferior Oolite of Somersetshire has not yet been accurately defined; and indeed it is only by palæontological characters that the one rock can be distinguished from the other. Lithologically, the rock in which *Diplocidaris Desori* is imbedded reminds me more of the Upper Lias of that region than of the Inferior Oolite.

I dedicate this species to my friend M. Desor, who has established the genus to which this urchin is referred.

B. *Species from the Inferior Oolite.*

DIPLOCIDARIS WRIGHTII, Desor. Pl. I, fig. 5 *a, b*.

[*Species of which the test is unknown.*]

DIPLOCIDARIS WRIGHTII. Desor, Synopsis des Echinides Fossiles, p. 45, pl. 7, fig. 24.

The spine on which M. Desor established this species was figured in my 'Memoir on the Cidaridæ of the Oolites,' and was, by mistake, drawn with the spines since ascertained to belong to *Cidaris Fowleri*. The articulating head is small, the rim of the acetabulum deeply crenulated, and the cup largely perforated; the ring is carinated and finely milled; one half of the neck is covered with longitudinal lines, and the other half is smooth (Pl. I, fig. 5 *b*); the stem is round, and gradually swells out towards the middle, where it is fractured; it is covered with small pustules, which are rather irregularly disposed on the surface, and not arranged in lines. M. Desor says it resembles the spines of *Diplocidaris gigantea*, but the stem is more swollen out in the middle than in that Corallian species.

Locality and Stratigraphical position.—I have fragments of three spines, which were all collected in the Pea Grit, Inferior Oolite, at Crickley Hill, along with the test and spines of *Cidaris Fowleri*.

NOTES

ON SOME FOREIGN JURASSIC SPECIES OF CIDARIDÆ NEARLY ALLIED TO BRITISH FORMS,
BUT WHICH HAVE NOT YET BEEN FOUND IN THE ENGLISH OOLITES.

Genus—CIDARIS.

A. Species from the Lias.

CIDARIS AMALTHEI. Quenstedt, Petrefactenkunde, p. 574, t. 48, figs. 28—30.

The inter-ambulacral plates only are known; they attain a large size, nearly an inch in breadth; the tubercles are not so large in proportion, but they are deeply crenulated, and have a large perforation in their summit; areolas elliptical, large, distinct; scrobicular granules not larger than those filling the miliary zone. Spines long, slender; stem with small, forward-directed prickles; head and acetabulum large; rim deeply crenulated; ring prominent; neck partially covered with fine longitudinal lines.

Formation.—Lias, Donau-Mainkanal bei Dörlbach.

Collections.—Museums of Bonn, Stuttgart; Professor Quenstedt. Specimens in my Cabinet sent by Dr. Fraas.

B. Species from the Inferior Oolite.

CIDARIS LORIERII, *Wright*, nov. sp., 1855.

Test high, one inch and two tenths, transverse diameter two inches, inclining to a pyriform figure, narrow towards the base, and broad and flat at the upper surface; ambulacra flat, with four rows of granules; poriferous zones as wide as the area, pores round, separated by thick septa; inter-ambulacra with seven or eight plates in each column; areolas wide, superficial, with sharply defined margins, surrounded by small granules, of the same size as those filling the miliary zone, which is narrow, and shows the centrosutural zigzag line well defined; bosses prominent, with broad, deeply crenulated summits; tubercles deeply and largely perforated, gradually increasing in size from the peristome to the coronal plates; disc opening small and circular.

Formation.—Collected by M. De Lorie from the étage Bajocien, département de Sarthe.

Collection.—My Cabinet.

This species comes very near to *Cidaris Fowleri*; but it is distinguished from that species by its pyriform figure, the circle of minute scrobicular granules, the wide areolas, broad and deeply crenulated bossal summits, and wide and deep perforations in the tubercles. These characters closely resemble those of *Cidaris confluens*, with which it has many affinities.

Sent me most kindly by M. De Lorie, to whom I dedicate this fine new species.

C. Species from the Coral Rag.

CIDARIS BLUMENBACHII. Münt., in Goldf., Petrefacten, p. 117, t. 39, fig. 3 *a*, *b* (testa non aculei).

Agassiz, Echinodermes Suisses, part ii, p. 57, t. 20, figs. 2—6.

Cotteau, Études sur les Échinides Fossiles, p. 108, t. 10, fig. 6?

Test inflated, depressed at both poles; ambulacra narrow and flexuous, with two rows of small, very close-set granules; poriferous zones narrow; pores small, round, contiguous, from 20 to 22 pores opposite one of the largest tubercular plates; areolas large, nearly circular, deeply excavated, six to seven in each row, with a prominent margin; boss small, summit broad, deeply crenulated; tubercle small and prominent; scrobicular circles complete, margins touching, granules scarcely larger than those filling the wide miliary zones. Spines not known, those referred to this species I have proved to belong to *Cidaris florigemma*.

Formation.—Coral Rag.

Localities.—Besançon, Châtel-Censoir, et Druyes, Yonne; Saint-Mihiel, Vaches-Noires. Corallien blanc de Hoggerwald, Canton de Soleure.

Jura superieur, Jurakalkes bei Thurnau und Muggendorf, Bavaria.

Formation ϵ , *Quenst.*, Sigmaringen.

Collections.—British Museum; very rare in English Collections; in almost all the Foreign Collections; my Cabinet.

CIDARIS PARANDIERI. Agassiz, Echinodermes Foss. Suisse, ii, p. 58, t. 20, fig. 1.

Test inflated; ambulacra narrow, with two rows of granules at the base, and sometimes two other intermediate rows—four rows in the middle; the areolas, bosses, and tubercles similar to the preceding species, of which it appears to be only a variety.

The spines referred to this species by M. Merian cannot positively be said to belong to it.

Formation.—Terrain à Chailles, Corallien.

Localities.—Fringeli, Canton de Soleure.

Corallien de Besançon, du département de l'Yonne.

Nattheim, Württemberg. Formation ϵ , *Quenst.*, d'Ulm, Württemberg.

Collections.—Museum of Vienna (Dudressier Collection).

British Museum.

CIDARIS DROGIACA. Cotteau, Études sur les Échinides Foss., p. 111, t. 11, figs. 1, 2.

Test very large, inflated, depressed both on the upper and under surfaces; tubercles large and prominent; bosses large, with deeply crenulated summits; uppermost plates of the inter-ambulacra with rudimentary tubercles, destitute of areolas; scrobicular circle elliptical; granules large and perforated; granules of the miliary zone likewise large, distant, and perforated; ambulacra narrow, with two rows of perforated granules; poriferous zones very narrow; pores very small and contiguous.

Formation.—Calcaire à Chailles de Druyes (Yonne).

Coral Rag Inferieur de Châtel-Censoir.

Localities.—Druyes, Châtel-Censoir, Yonne.

Collection.—M. Cotteau, École des Mines, Paris.

Plaster mould, in my Cabinet, sent by M. Cotteau.

CIDARIS SUEVICA. Desor, Synopsis des Échinides Foss., p. 7, t. 1, fig. 2.

Test large, inflated, depressed on the upper and under surfaces; areolas circular, deeply excavated; bosses prominent, summits finely and deeply crenulated; tubercles moderate sized; miliary zone covered with a fine, abundant, homogeneous granulation; scrobicular circle with granules of the same size as those filling the zone; ambulacra with two rows of unequal-sized granules.

Formation.—Argovien?

Locality.—Württemberg.

Collections.—Museums of Tübingen, Zurich.

CIDARIS PROPINQUA. Münst., in Goldfuss, Petrefact., p. 119, t. 40, fig. 1.

Agassiz, Echin. Fos. Suisse, ii, p. 62, t. 21, figs. 5, 6, 7, 9, 10.

Test small, depressed; ambulacra much flexed, with two rows of marginal granules; poriferous zones narrow, sunk; pores small, contiguous; inter-ambulacra with four or five plates only; areolas small; bosses small, summits nearly smooth; tubercles very large and prominent; scrobicular circles complete, touching, formed of prominent spaced-out granules. Spines short, elliptical, clavate; stems much swollen out in the middle, and tapering to a point at their distal extremity, covered with longitudinal rows of large, distinct granules.

Formation.—Coral Rag, Jura blanc, (Argovien étage?)

Localities.—Baireuth.

Argovien des Lägern, du Randen.

Argovien (formation γ , *Quenstedt*) Sirchingen, Württemberg.

Environs de Metz, Moselle.

Collections.—Museums of Zurich, Bale, Tübingen, Neuchatel.

British Museum, my Cabinet.

CIDARIS ELEGANS. Münst., in Goldfuss, Petrefact., p. 118, t. 39, fig. 5.

Test small, depressed; areolas small, circular; tubercles large and prominent, bosses crenulated; scrobicular circle formed of spaced-out granules; ambulacra with two rows of marginal granules. Spines short, clavate; stem covered with small granules.

Formation.—Coral Rag of Baireuth, Bavaria.

Coral Rag of Nattheim, Sigmaringen, Württemberg. Formation ϵ , *Quenst.*

Collections.—Museums of Bonn, Tübingen, Stuttgart, my Cabinet.

CIDARIS CORONATA.—Goldf., Petrefact., p. 119, t. 39, fig. 8.

Agassiz, Echinod. Foss. Suisse, ii, p. 59, t. 20, figs. 8—17.

Quenstedt, Petrefactenkunde, t. 48, figs. 16—21, with beautiful and accurate details.

Desor, Synopsis des Échinides Foss., p. 9, t. 1, fig. 1.

Test moderate sized, much depressed; ambulacra flexuous and prominent, with four rows of small, close-set granules in the middle, diminishing to two rows in the upper and lower parts of the area; poriferous zones sunk; pores small, round, contiguous; inter-ambulacra with from four to five plates in each column; areolas large, circular; rim prominent, surmounted by a scrobicular circle of round, prominent, spaced-out granules; bosses with feebly crenulated summits above, nearly, if not quite, smooth below; tubercles large and prominent; disc opening very large; miliary zone filled with numerous small, round granules; a considerable granulated space between the scrobicular circles. Spines round, with the head large; neck long, smooth; stem swollen out, and then gradually tapering to a blunt point; surface covered with a confluent granulation, arranged in parallel carinated, longitudinal lines.

Formation.—Coral Rag of Sigmaringen, Württemberg, and Bavaria. Formation γ , *Quenstedt*.

Coral Rag Inferieur, et Calcaire à Chailles, Châtel-Censoir et Druyes, Yonne.

Collections.—In all the Foreign Collections.

British Museum, Bristol Museum, Scarborough Museum. It is often mistaken for and ticketed as a British fossil. My Cabinet.

CIDARIS MARGINATA. Goldf., Petrefact., p. 118, t. 39, fig. 7.

Test nearly as large as *Cidaris Blumenbachii*, slightly depressed at both poles; ambulacra prominent, with six rows of small, compressed granules in the middle of the area, diminishing to four rows above and below; five or six pairs of plates in the inter-ambulacra; the areolas large, circular, and much excavated; margin prominent, and surrounded with a circle of scrobicular granules, not much larger than those filling the miliary zone; bosses small, with smooth summits; tubercles large; poriferous zones deeply sunk; pores small, round, and contiguous; miliary zone wide, filled with small, close-set granulations. Spines round; head and acetabulum large, with a smooth rim; neck thick, short, and smooth; stem covered with lines of granules.

Formation.—Coral Rag of Nattheim. Formation ϵ , *Quenstedt*.
Jura Supérieur Heidenheim.

Collections.—Museums of Bonn, Tübingen, Stuttgart, and others.
British Museum, my Cabinet.

D. Species from the Kimmeridge Clay.

CIDARIS BOLONIENSIS, *Wright*, nov. sp., 1855. Figured in Mr. Davidson's MSS., pl. 1, figs. 11, 12.

Form unknown, plates and spines only found. Ambulacra very narrow, with two rows of small granules; poriferous zones as wide as the areas; pores oblong, separated by thick septa; inter-ambulacra wide, plates twice and a half as broad as they are deep; areolas elliptical, central, much excavated; bosses small, summits broad and deeply crenulated; tubercles large, gradually increasing in size from below upwards; scrobicular circle complete in the upper areolas; granules small, a little larger than those in the zone; miliary zone wide; the granules diminish in size between the scrobicular circle and the centrosutural line; a second miliary zone between the scrobicular circle and the poriferous zones. Spines long, cylindrical, or a little compressed; head very large; rim of the acetabulum deeply crenulated; ring very prominent, forming a carina milled with microscopic lines; neck long, lower half covered with fine longitudinal lines, upper half smooth; stem nearly round, and closely covered with small granular longitudinal lines, compressed at the extremity; arising, at irregular intervals, from among the granular lines, are a number of short, stout, thorn-like, forward-directed prickles; in some of the more spatulate varieties of the spines the prickles are not conspicuous, but in the round forms they are very prominent processes.

M. Bouchard Chantereaux, of Boulogne, who kindly sent me the specimens, at the same time states, "they are the only *débris* of the species that I have yet found. If we may judge of the size of this urchin by the dimensions of the tubercular plates, this species must have been at least four times larger than *Hemicidaris Boloniensis*, which you have now."

This *Cidar*is was most accurately figured in detail by my excellent friend Mr. Davidson, in Pl. I of an 'Atlas of Plates illustrative of the Fossils of the Boulonnais,' and which plates have been most obligingly placed at my disposal for this work.

Formation.—Kimmeridge Clay, near Boulogne-sur-Mer.

Collections.—M. Bouchard Chantereaux, Mr. Davidson, my Cabinet.

Genus—RABDOCIDARIS.*B. Species from the Inferior Oolite.*

RABDOCIDARIS MAXIMA. Syn. *Cidarites maximus*. Münst., in Goldf., Petrefact., p. 116,
t. 39, fig. 1.

Test large, very high, having at least seven tubercular plates in each inter-ambulacral column; areolas large, elliptical, confluent; bosses with deeply crenulated summits; tubercles large; scrobicular circles incomplete; granules small, not larger than those filling the miliary zones; ambulacra broad, with two rows of marginal granules, and an interspace between; poriferous zones nearly straight, and broad; pores oblong, wide apart. Spines long, round; head large, neck long and smooth, stem swollen out in the middle; surface armed with irregularly disposed, forward-directed, thorny spines.

Formation.—Inferior Oolite of Baireuth. Formation, Brauner Jura δ, *Quenst.*

Collection.—Museums of Bonn and Stuttgart; plates and spine in my Cabinet.

C. Species from the Coral Crag.

RABDOCIDARIS NOBILIS. Syn. *Cidarites nobilis*. Münst., in Goldf., Petrefact., p. 117,
t. 39, fig. 4.
Agassiz, Echinod. Foss. Suisse, ii, p. 65,
t. 21 a, fig. 21.
Desor, Synopsis Échinides Foss., t. 8,
fig. 10.

Test large, thin, spheroidal, depressed at both poles; ambulacra broad, slightly flexed, with six rows of small granules; poriferous zones narrow; pores small, round, separated by thick septa: inter-ambulacra wide; seven large plates in each column; areolas large, circular, superficial; bosses small, not prominent, summits deeply crenulated; tubercles large and prominent; scrobicular circles complete; granules small, a little larger than those filling up the zones. The scrobicular circles of the lower plates touch; those of the upper plates are separated by a miliary space; miliary zone very wide, covered with numerous granules, which diminish in size from the scrobicular circle to the centro-sutural line, which is very distinctly visible. Spines long, cylindrical or sub-prismatic; the head large; neck smooth, concave; stem very long, sometimes twelve inches in length, *Quenstedt*;

surface covered with short, thorn-like, forward-directed prickles, which in prismatic varieties are disposed in lines; base of the stem slightly enlarged; the remainder of the stem is narrower, and of a uniform width throughout.

Formation.—White Jura (Argovien)? Baireuth.

White Jura, Coral Rag, Württemberg. Formation ϵ , *Quenst*.

Collections.—Museums of Vienna, Tübingen, Stuttgart.

British Museum, my Cabinet.

D. *Species from the Kimmeridge Clay.*

RABDOCIDARIS ORBIGNYANA. Desor, Synopsis des Échinides Fossiles, p. 40, t. 1, fig. 3.

Test large, spheroidal; ambulacra broad, flat, with four rows of granules; poriferous zones as wide as the area; pores small, round, placed far apart by thick septa; interambulacra with seven or eight plates in a column; areola circular, superficial; boss prominent, summit broad and deeply crenulated; tubercles large and widely perforated; scrobicular circles complete; granules small, well spaced out, and raised on a base; miliary zone moderately wide, and filled with small granules, which gradually diminish in size between the scrobicular circle and the centro-sutural line, which is well defined. Spines long, tricarinate or prismatic, from three to four inches in length; sometimes they are compressed and flattened near their distal extremity; the head is small, the rim of the acetabulum is deeply crenulated, the ring is narrow, the neck short and smooth; at the base, and along the edges of the carinæ, there are rows of stout, short, forward-directed, thorn-like prickles; the intermediate surface of the stem is covered with longitudinal lines of small, irregular-sized granules.

Formation.—Kimmeridge Clay, Rochelle, Villersville, Cap la Hève, Havre.

Collections.—MM. Michelin, Cotteau, Thurmann.

British Museum, Jermyn Street Museum, my Cabinet.

Genus—DIPLOCIDARIS.

- DIPLOCIDARIS GIGANTEA. Syn. *Cidaris gigantea*. Agass., Echin. Foss. Suisse, ii, p. 66,
t. 21, fig. 22.
„ „ Quenstedt, Petrefactenkunde, t. 48,
fig. 45.
Diplocidaris gigantea. Desor, Synopsis Échinides Foss.,
t. 1, fig. 5.

Test large; ambulacra straight, with two rows of marginal granules; poriferous zones wide; pores bigeminal throughout; interambulacra wide; areolas superficial, small in proportion to the size of the plates; bossal summits deeply crenulated; tubercles small and perforated; scrobicular circle composed of large, mammillated, spaced-out granules. Miliary zone wide, filled with granules placed wide apart; between the areolas and the poriferous zones, there is a wide miliary zone; the uppermost plates of the inter-ambulacra are destitute of primary tubercles, the miliary granules covering their entire surface. Spines stout, cylindrical; stem covered with numerous equal-sized granules, which are nearly longitudinal in their disposition, but have no connecting calcareous filament; acetabulum large, rim deeply crenulated, ring prominent, neck short and smooth.

Formation.—Coral Rag of Besançon, Salins, Châtel-Censoir, and Druyes, Yonne.

Coral Rag of Nattheim, “Weissen Jura, &c., bei Ulm,” *Quenst.*
Württemberg.

Collections.—Museum of Vienna (Dudressier Collection), Tübingen, Collections of
M. Cotteau and M. Michelin.

Family 2—HEMICIDARIDÆ.

Test thick, spheroidal, more or less depressed; mouth opening large, central; peristome decagonal, and divided by notches, more or less deep, into ten unequal-sized lobes.

Apical disc small, directly opposite the mouth, composed of five genital plates, and five ocular plates; the anterior pair of genital plates are larger than the posterior pair, and the right antero-lateral, which always supports the madreporiform body, is the largest. Anal opening round or oval in the centre of the genital circle.

Ambulacral areas wider than in the CIDADRIDÆ, with semi-tubercles at their base only, as in *Hemicidaris*, or extended throughout the area as in *Acrocidaris*; these tubercles are perforated, and provided with crenulated bosses like those occupying the inter-ambulacra; the areas are straight or undulated.

Inter-ambulacral areas wide, composed of large plates, rarely more than eight in each column; the external surface of the plates supports large perforated tubercles, raised on very prominent bosses; the areolas are in general oblong, and confluent above and below; the incomplete scrobicular semicircles form two crescents on the sides, and they alone form the narrow, central, miliary zone. One small group, *Acropeltis*, has the bosses smooth, and the tubercles imperforate.

The poriferous zones are narrow and undulated; the pores are small, contiguous, and unigeminal throughout, except near the peristome, where they are bigeminal and trigeminal.

The jaws are large and powerful, and armed with stout tricarinate teeth. The spines in general are long, cylindrical, and tapering; sometimes they are claviform or stout, compressed, and angular. Their surface is in general covered with fine longitudinal lines; but, as far as we know, neither prickles nor asperities are developed on the stem.

I have grouped in this family the genera *Hemicidaris*, *Acrocidaris*, and *Acropeltis*, which are all extinct, and found in the Oolitic, Cretaceous, and Tertiary Formations.

Genus—HEMICIDARIS, *Agassiz*. 1840.CIDARITES (pars), *Lamarck*. 1816.CIDARITES (pars), *Goldfuss*. 1829.DIADEMA (pars), *Desmoulins*. 1835.

The genus *Hemicidaris* was established by Agassiz,* to receive certain urchins which Lamarck and Goldfuss had included in the genus *Cidarites*, and Desmoulins had placed among his *Diademas*. The dismemberment of these forms from the genera with which they had been associated, was an important progressive step in stratigraphical palæontology, as they form extinct types of the Echinoidea, which, up to the present time, have only been found in the Oolitic, Cretaceous, and Nummulitic Formations.

The species of this genus exhibit a group of characters which are easily recognised, even when portions of the test only are preserved.

If the reader will please to compare Plates I and II with Plates III and IV of this work, he will discover at a glance how widely different the general *facies* and structure of the test in *Hemicidaris* is from that of the true *Cidaritis*.

The *Hemicidaris*, in general, have the test thick, of a medium size, more or less subglobose, and generally flattened at the base; the altitude being greater in proportion to the latitude than in either the CIDARIDÆ, DIADEMADÆ, or ECHINIDÆ. The distinctive character of the genus lies in the structure of the ambulacral areas, which are narrow, and more or less flexuous. At the enlarged base of each area (Pl. IV, fig. 1 *b*, *c*, *d*) there are three or four pairs of mammillated tubercles, which occupy the lower fourth part of the area. These *semi-tubercles* are smaller in size, but identical in structure, with the primary tubercles of the inter-ambulacral areas, and, like them, they gradually increase in magnitude from below upwards. The upper three fourths of the area has two marginal rows of minute perforated tubercles, which contrast strongly with the large semi-tubercles they immediately succeed. Between the minute marginal tubercles there is a narrow miliary zone, containing two or more rows of small, close-set granules.

The poriferous zones are narrow; the pores are unigeminal, and approximated on the sides, but near the peristome they become bigeminal and trigeminal, according as the space in that region is more or less augmented.

The inter-ambulacral areas are wide, with two rows of primary tubercles, from four to eight in each row. They have large, prominent bosses, with deeply crenulated summits, especially those near the equator of the test; the areolas are wide, and mostly confluent above and below, so that the scrobicular circle of granules is generally incomplete. In some species the tubercles increase and diminish gradually in the area; in others,

* 'Description des Echinodermes Fossiles de la Suisse,' part ii, p. 42.

the large equatorial tubercles are succeeded by others, which diminish suddenly in size.

The mouth opening is large; the peristome is decagonal, its margin being always divided into ten lobes by deep notches; the five jaws, when preserved (Pl. IV, fig. 1 *b*), are always large and powerful.

The apical disc is small, its elements are very solid, and so well articulated with the areal plates, that it is very often preserved in the fossil state. It forms, in this respect, a remarkable contrast to the apical disc in *Cidaris*, which is large, and almost always absent. The anterior pair of genital plates are larger than the posterior pair, the right antero-lateral plate being the largest, and always supporting a prominent spongy madreporiform body; the single posterior plate is often small and rudimentary, from the encroachment of the vent; the five ocular plates are small, prominent, heart-shaped bodies, with marginal orbits, whereas the oviductal holes of the genital plates are pierced at some distance from the border; the surface of all the discal elements is covered with small granules.

The primary spines are in general long, tapering, and cylindrical, but sometimes they are claviform; their surface is smooth, and sculptured with fine longitudinal lines (Pl. IV, fig. 1 *h, n, o*); the secondary spines are small, short blunt processes (fig. 1 *j, k*).

The size of the species in this genus varies from half an inch to two inches in diameter, and from two tenths of an inch to an inch and three quarters in altitude.

Hemicidaris is distinguished from *Cidaris* by the breadth and structure of the ambulacra, and the presence of semi-tubercles at the bases of these areas. It is distinguished from *Diadema* by the narrowness of the ambulacra, and the presence of minute marginal tubercles only on the sides of the ambulacra, *Diadema* having primary tubercles as large as those in the inter-ambulacra, ranging throughout these divisions of the test.

Hemicidaris very much resembles *Acrosalenia*, many species of this latter genus having been mistaken for the former. *Hemicidaris* may be readily distinguished by the great difference in size between the uppermost pair of semi-tubercles and the lowest pair of minute marginal tubercles, but, above all, by the size of the discal opening, and the structure of the apical disc itself, which in *Acrosalenia* has one or more sur-anal plates; even when the elements of the disc are absent, there is always a certain amount of excentricity in the opening, one angle thereof intruding farther down the single inter-ambulacrum than into either of the other inter-ambulacral areas.

Hemicidaris is distinguished from *Acrocidaris* by the narrowness of the ambulacra, and by the semi-tubercles being limited to the bases of the areas, whereas in *Acrocidaris* the ambulacra are wide, and furnished with primary tubercles throughout; each of the genital plates likewise is furnished with a large perforated tubercle, raised on a crenulated boss.

The genus *Hemicidaris* may be subdivided into three sections, of each of which we have typical examples in our Oolitic formations:

Section *a*.—Test elevated, tubercles large in the upper parts of the inter-ambulacra.

Examples: *Hemicidaris intermedia*, *Hemicidaris crenularis*, *Hemicidaris Bravenderi*.

Section *b*.—Test large, depressed; tubercles suddenly diminishing in size on the upper part of the inter-ambulacra.

Examples: *Hemicidaris diademata*, *Hemicidaris Stokesii*, *Hemicidaris pustulosa*.

Section *c*.—Test in general small; ambulacra very flexuous; tubercles in the inter-ambulacra few in number, but large in size, and very prominent.

Examples: *Hemicidaris minor*, *Hemicidaris Thurmanni*.

A. *Species from the Inferior Oolite*.—10th *Étage*, Bajocien, d'Orbigny.

HEMICIDARIS GRANULOSA, *Wright*. Pl. III, fig. 2 *a—f*.

HEMICIDARIS GRANULOSA. Wright, Annals and Magazine of Natural History, 2d series, vol. viii, p. 257, pl. ii, fig. 4 *a, a*.

— — Desor, Synopsis des Échinides Fossiles, p. 55.

— — Morris, Catalogue of British Fossils, 2d edit., p. 82.

Test sub-spheroidal, depressed at both poles; ambulacral areas straight, with two marginal rows of prominent, well-defined, imperforate granules, and three pairs of semi-tubercles at the bases thereof; inter-ambulacral areas, with three pairs of primary tubercles, extending only as far as the equator, the upper tubercular plates being covered with warty granules; apical disc large, and not prominent; base flat; mouth opening large; peristome slightly notched.

Dimensions.—Height, seven tenths of an inch; transverse diameter, one inch and one tenth.

Description.—This remarkable Urchin is closely allied to *Hemicidaris pustulosa*, Agassiz, and replaces that Dorsetshire species in the same zone of the Inferior Oolite at Dundry. The test is hemispherical, flat below, and slightly depressed above (Pl. III, fig. 2 *c*); the ambulacral areas are straight and prominent, they have two marginal rows of from ten to twelve large, prominent, imperforate granules, which are smooth and deformed, and set regularly in alternate rows, the intervening surface of the plates being filled with small, ill-defined, and irregularly arranged miliary granules (Pl. III, fig. 2 *d*); the bases of the areas are wide, to allow of the development of three pairs of moderately sized semi-tubercles (Pl. III, fig. 2 *b*); the poriferous zones are nearly straight, except where they follow the

basal expansion of the areas; the pairs of pores (Pl. III, fig. 2 *d*) are placed slightly oblique, and the septa have raised eminences, which form a moniliform division between the pores; there are ten to eleven pores opposite each large tubercular plate, and at the wide basal region of the zones they fall into triple oblique pairs.

The inter-ambulacral areas are twice and a half the width of the ambulacral; they had from six to seven large plates in each column, the three or four inferior plates alone supporting large primary tubercles; the three upper plates are destitute of them, and, in lieu thereof, have clusters of granules, similar in size to those of the ambulacra, developed on their surface, and forming triangular, quadrangular, or pentagonal figures, according to the number of granules in each group (Pl. III, fig. 2 *a*); the large primary tubercles occupy the entire surface of the rhomboidal plate (fig. 2 *d*); the boss is large and prominent (fig. 2 *e*), its summit is deeply crenulated, and the tubercle is likewise large and deeply perforated; the areolas are smooth and gently inclined (fig. 2 *e*), and around them is a complete scrobicular circle, formed of from thirteen to fifteen round granules (fig. 2 *d*); the base is flat (Pl. III, fig. 2 *b*); the mouth opening is very large, thirteen twentieths of an inch, that of the diameter of the test being one inch and two tenths; the peristome is not so deeply notched as in many other congeneric forms.

The apical disc is concealed by hard adherent rock in the larger specimen, but is well exposed in a smaller one (fig. 2 *a*); it consists (fig. 2 *f*) of elongated heptagonal genital plates, the one carrying the madreporiform body is the largest; the oviductal holes are pierced near the apices; the ocular plates are distinctly heart-shaped, with a depression down the centre of each, the orbit being formed by the notch; the disc makes a slight prominence on the upper part of the test, and the surface of the plates is destitute of any sculpture; the anal aperture is circular and central (fig. 2 *f*).

Affinities and differences.—This Urchin very much resembles *Hemicidaris pustulosa*, Agassiz, but is distinguished from it in having narrower ambulacra, with larger, fewer, and more prominent granules thereon; the inter-ambulacra have likewise fewer primary tubercles, and their areolas are surrounded with complete circles of well-spaced-out scrobicular granules (fig. 2 *d, e*), whereas in *Hemicidaris pustulosa* the areolas are confluent.

It is distinguished from *Hemicidaris intermedia* by the absence of tubercles from the upper parts of the inter-ambulacra, and by the form and size of the granules covering the ambulacra. It is so entirely distinct from all other congeneric forms, that it is impossible to mistake it for either of them.

Locality and Stratigraphical position.—The two specimens figured in Pl. III, fig. 2, were collected from the Inferior Oolite of Dundry Hill, associated with *Diadema depressum*, *Echinus germinans*, and *Polycyphus Forbesii*. In Mr. Lowe's cabinet there is a fine specimen of this species, showing the base very well, which was collected from the Forest Marble near Corsham, Wilts.

History.—This species was first figured in my ‘Memoirs on the Cidaridæ of the Oolites,’ published in the ‘Annals of Natural History,’ October, 1851. It is a very rare Urchin; fine specimens of it are contained in the British Museum, Bristol Museum, and in my collection; the only known localities are those already mentioned.

HEMICIDARIS PUSTULOSA, *Agassiz*. Pl. III, fig. 1 *a, b, c, d, e*.

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| HEMICIDARIS PUSTULOSA. | Agassiz, Catalogus Systematicus, p. 8. |
| — | — Agassiz and Desor, Catalogue raisonné Annales des Sciences Naturelles, 3 ^e série Zool. tome vi, p. 338. |
| — | — Desor, Synopsis des Échinides Fossiles, p. 53. |
| — | — D’Orbigny, Prodrome de Paléontologie, tome i, p. 320, No. 420. |

Test large and sub-conoidal; ambulacral areas wide and straight; semi-tubercles large, wide asunder, upper part covered with homogeneous granules, those on the margins the largest; inter-ambulacral areas narrow, with two rows of prominent primary tubercles, which disappear a little way above the equator; the uppermost four or five tubercular plates have clusters of from six to ten homogeneous granules developed on their surface; apical disc large and very prominent, the elements thereof forming a considerable elevation on the test; mouth opening large. Spines thick, oval, with a ridge on one side.

Dimensions.—A. Agassiz’s type specimen, from the Great Oolite, Ranville. Height, one inch and one twentieth of an inch; transverse diameter, one inch and seven tenths of an inch.

B. Height of the specimen figured (Pl. III, fig. 1), seven tenths of an inch; transverse diameter, one inch and three tenths of an inch.

Description.—In the examination of the species of the genus *Hemicidaris*, the palæontologist often experiences much difficulty in finding on the test alone good characters for the separation of forms which, from the study of the entire organism, he knows to be distinct, but which, were he to rely merely upon the shell, he would pronounce to be identical; this circumstance has doubtless led to much confusion among the members of this group; no such difficulty, however, exists in the species now under consideration, as it is marked by characters so prominent and well defined, that when it is once seen it cannot possibly be mistaken for any but one of its congeners.

Hemicidaris pustulosa was first discovered by Professor Deslongchamps, in the Great Oolite of Normandy, and entered by Agassiz in his ‘Catalogus Systematicus. These specimens have been most kindly communicated to me by Professor Deslongchamps. But it has never, until now, been either figured or described.

The test is large, with a broad base; it is inflated about the equator; from this point

the shell rises into a sub-conoidal form, with a prominent and elevated apical summit; the ambulacral areas are wide and nearly straight, so much so that I have received specimens from France that were ticketed as *Diadema*; the base of the areas is expanded, and there are from six to seven pairs of semi-tubercles in this region, which are well spaced out and very prominent, with a small granule at the angle of each zigzag interspace; the upper part of the areas has two marginal rows of imperforate granules, not very regular, however, in their arrangement, and between them are several smaller granules, equally irregular in size and disposition; the poriferous zones are rather wavy and of moderate width; the pores have an elevated granule rising from the surface of the septa, and separating them, which produces a moniliform line in the track of the zones; the pairs of pores are nearly horizontal, and unigeminal, from the disc to the equator; the zones at this point bend outwards, to form enlarged spaces for the basal semi-tubercles; as the zones approach the peristome, the pores lie in triple oblique pairs.

The inter-ambulacral areas at the equator are only twice the width of the ambulacral areas (Pl. III, fig. 1 *b*), and, what is very unusual among the Echinidæ, they are more prominent than the ambulacra; the primary tubercles are limited to the inferior and middle parts of the areas, one or two only extending above the equator of the test (Pl. III, fig. 1 *c*); they are surrounded by areolas, which are confluent both above and below, and have semicircles of five or six pustulose granules on their outer and inner margins. On the upper part of the areas the true tubercles disappear (Pl. III, fig. 1 *a*); the surface of the tubercular plates in this region develops only clusters of granules, which are very irregular in their mode of arrangement, but uniform in size and form; the first tubercular plates above those having true primary tubercles have a small imperforate tubercle in the centre, and a cluster of granules around it, but the three or four plates between this and the disc are covered with a homogeneous granulation; the areolas of the primary tubercles are separated from the poriferous zones by semicircles of granules (Pl. III, fig. 1 *c*), and like semicircles of scrobicular granules separate the areolas in the median line from each other; there are from eight to ten plates in each tubercular column.

The apical disc is large and very prominent, and forms a conspicuous elevation at the summit of the sub-conoidal test (Pl. III, fig. 1 *a*, *e*); the antero-lateral genital plates are the largest; the postero-laterals nearly equal them in size and figure, and the single plate is the smallest; the madreporiform body forms a kind of warty eminence on the surface of the right antero-lateral plate, which is the largest; the ocular plates are heart-shaped, and project like tubercles from between the angles formed by the genital plates; the surface of all the elements of the disc, the genital, and even the ocular plates, is covered with numerous granules. (Pl. III, fig. 1 *e*.)

The spines are only known by a fragment, which is imbedded in the base of a specimen from St. Aubin de Langrune. This spine is thick and oval, with a ridge on one of its sides.

The mouth opening is large, and the peristome is not deeply notched; the anal opening is obliquely oval.

Affinities and differences.—This species closely resembles *Hemicidaris granulosa* in the presence of granules instead of tubercles, on the upper part of the test. It is distinguished from it by the following characters: the form is more conoidal, the ambulacra are wider, the granules on the same are smaller and more numerous; the scrobicular circles are incomplete, and the surface of the plates of the apical disc is covered with granules. *Hemicidaris pustulosa* resembles *Hemicidaris Stokesii* (Pl. III, fig. 3) in the sudden diminution in the size of the tubercles on the upper parts of the inter-ambulacral areas, and in the granulated character of the surface of the apical disc; but it is distinguished from that species in having unequal-sized, irregularly disposed marginal granules on the ambulacral areas. The tubercles of the two upper inter-ambulacral plates in *Hemicidaris Stokesii* are perforated, with distinct scrobicular circles around their areolas (Pl. III, fig. 3 a); whereas in *Hemicidaris pustulosa* the rudimentary tubercles and the scrobicular granules form clusters on the plates (Pl. III, fig. 1 a). The elements of the apical disc, in both species, are much alike in form, structure, and sculpture. The disc, however, in *Hemicidaris Stokesii* does not rise above the surface; whereas in *Hemicidaris pustulosa* it forms a marked projection. There is no other Oolitic species of *Hemicidaris* at present known for which *Hemicidaris pustulosa* can be mistaken.

Locality and Stratigraphical position.—The only English specimen I have seen was presented to me by my excellent friend Mr. Etheridge. The exact locality in Dorsetshire from whence it was collected, however, is not known; but, judging from the lithological character of the rock in which it is imbedded, it is probable it came from the Inferior Oolite near Bridport.

The French specimens were found in the “Grand Oolite (Bathonien), de Luc, St. Aubin, Langrune, Calvados.”—*Deslongchamps*.

History.—This species was first entered in the ‘Catalogus Systematicus’ of Agassiz, and afterwards in the ‘Catalogue raisonné’ of Agassiz and Desor, but it is now figured and described for the first time.

B. *Species from the Stonesfield Slate, Great Oolite, Bradford Clay, Forest Marble, and Cornbrash.*—11th Étage, Bathonien, d’Orbigny.

HEMICIDARIS STOKESII, *Wright*, nov. sp., Pl. III, fig. 3 a, b, c.

CIDARIS FROM STONESFIELD. Stokes, Transactions of the Geological Society of London, 2d series, vol. ii, pl. 45, fig. 17.

Test circular, depressed; ambulacral areas straight, with two rows of small regular marginal tubercles; inter-ambulacral areas with large primary tubercles at the equator,

and disproportionately small tubercles on the upper parts of the area ; apical disc large, and composed of nearly equal-sized plates.

Dimensions.—Antero-posterior diameter, one inch and five tenths. Height unknown.

Description.—This beautiful species has been hitherto overlooked by English palæontologists, notwithstanding the very excellent figure given of it in the Transactions of the Geological Society, 2d series, by the late Mr. Charles Stokes. I have not been able to discover the original specimen, but through the kindness of Professor John Phillips, of Oxford, I am enabled to figure a much better specimen, recently discovered by him at Stonesfield. Unfortunately the upper surface of this specimen, like that figured by Mr. Stokes, is alone exposed, the under surface being irremovably surrounded by the rock.

The ambulacral areas are straight, and rather wide ; they are provided with two marginal rows of small tubercles, set on slightly prominent elevations (fig. 3 *b*) ; a few small miliary granules form incomplete circlets around their base ; the under surface and semi-tubercles are concealed ; but the apex is not much narrowed, and forms a rather obtuse arch (in the figure the ambulacra is drawn rather too lanceolate), over the summit of which the heart-shaped prominent ocular plates are rather conspicuously placed.

The inter-ambulacral areas are nearly three times the width of the ambulacra ; the primary tubercles are large and prominent at the equator of the test, but they suddenly diminish in size at the upper part of the areas, so that the two upper tubercles of each row are disproportionately small when compared with those at the equator. The bosses of the large tubercles rise prominently from a narrow areola, and are sculptured with about twenty crenulations at their summits ; the areola is surrounded with a complete circle of small round scrobicular granules (fig. 3 *b*) ; the pores in the zones are small, and placed widely apart, the rounded surface of the thick septa forming a moniliform line down the middle of the zone.

The apical disc is large (fig. 3 *c*) ; the genital plates are of nearly the same size ; the madreporiform body is spongy and prominent, and occupies almost the whole of the surface of the right antero-lateral plate, which is the largest ; the genital foramina open at the centre of mammillated elevations, near the apices of the plates ; there are two small tubercles near the base of the postero-lateral and single plates, and four on the surface of the left antero-lateral, as if the pair belonging to the right antero-lateral plate had been transposed to its fellow of the left side, in consequence of the madreporiform body occupying nearly all the surface of the right plate ; the anal opening is central and circular ; the ocular plates form heart-shaped elevations around the circumference of the disc ; each of the three anterior ocular plates support two small tubercles, but on the posterior pair there is only one on each plate.

The under surface of the test is unfortunately so much embedded in the rock, that its

removal therefrom is impossible ; we are, therefore, in ignorance about many important points relating to the anatomy of this species.

Affinities and differences.—*Hemicidaris Stokesii* resembles *Hemicidaris pustulosa* and *Hemicidaris diademata*, in having straight ambulacral areas and disproportionately small tubercles on the upper parts of the inter-ambulacra. From *Hemicidaris pustulosa* it is readily distinguished by its regular rows of small marginal tubercles in the ambulacral areas, with miliary granules between them, and in having small, single, primary tubercles only on the upper parts of the inter-ambulacral areas, but no clusters of granules thereon, as in *Hemicidaris pustulosa*. The test likewise is much more depressed, and the apical disc is not so prominent. Professor Agassiz observes* of *Hemicidaris diademata*, that the essential character consists in the rapid diminution of the large tubercles on the upper part of the inter-ambulacral areas ; a unique peculiarity in this genus, forming a remarkable contrast to the exuberance of these same tubercles in other species of *Hemicidaris*. The discovery, however, of *Hemicidaris pustulosa* and *Hemicidaris Stokesii*, show that this character is shared in common with other congeneric forms. From *Hemicidaris diademata* this species is distinguished by having the ambulacral areas straighter, the tubercles on the upper parts of the inter-ambulacral areas larger ; and the miliary granules are likewise larger and less numerous than those which cover the plates in *Hemicidaris diademata* ; but in other respects, as far as I can make a comparison, there is a very close affinity between these species.

Locality and Statigraphical range.—This species was first collected by the late Mr. Charles Stokes, from the Stonesfield Slate at Stonesfield ; and the urchin I figure was collected from the same rock and locality by Professor John Phillips, who has kindly communicated the specimen for my monograph. In the Stonesfield Slate at Eyford, Gloucestershire, a portion of a *Hemicidaris* has been occasionally found, which belongs likewise to this species. When we consider the enormous surface of this rock which is annually exposed by the splitting of the same into slates, and the very few specimens that have been found during the many years the quarries have been worked, we must consider *Hemicidaris Stokesii* as one of the rarest species of our Oolitic Urchins.

History.—First figured by Mr. Stokes, in the Transactions of the Geological Society ; as the type specimen appears to have been unknown, and as it was not named by its discoverer, it was not entered in our lists of species. It is now described for the first time. The specimen figured belongs to the Oxford Museum ; I have prepared plaster moulds from the same for the British Museum, Geological Museum, Jermyn Street, and the Bristol Institution.

* 'Echinodermes Fossiles de la Suisse,' part ii, p. 49.

HEMICIDARIS LUCIENSIS, d'Orbigny, Pl. III, fig. 6 *a, b, c, d, e, f*.

HEMICIDARIS LUCIENSIS. D'Orbigny, Prodrôme de Paléontologie, tome i, p. 320.

— — Desor, Synopsis des Échinides Fossiles, p. 52.

— CONFLUENS. Forbes, Memoirs of the Geological Survey, Decade V, description of pl. 5. Notes on Hemicidaritis.

Test sub-spheroidal, flat at the base, and depressed on the upper surface; ambulacral areas straight below, sinuous above, more especially in large adult individuals; four pairs of semi-tubercles, which increase gradually in size from the peristome upwards; two marginal rows of small tubercles perforate and crenulate, with intervening miliary granules below, but imperforate and approximated above; inter-ambulacral areas with from six to seven pairs of primary tubercles; apical disc prominent; base flat; mouth opening large; peristome with nearly equal-sized lobes.

Dimensions.—A. Height, seven tenths of an inch; transverse diameter, one inch and three twentieths of an inch.

B. Height, eleven twentieths of an inch; transverse diameter, one inch.

C. Height, five tenths of an inch; transverse diameter, eight tenths of an inch.

Description.—This Hemicidaritis, it appears, was mistaken on the Continent for *Hemicidaritis crenularis*, Lamarck, of the Coral Rag, from which it has been with justice separated by M. d'Orbigny; it has, up to the present time, been overlooked as an English urchin, the specimens hitherto found at Minchinhampton having been almost indeterminate. One specimen, however, collected from a band of clay in the Great Oolite, and communicated by my friend Mr. Lycett, has enabled me to compare this form with a good series of type specimens sent from Luc, Ranville, and Langrune, by MM. Michelin and Deslongchamps; so that the English specimens are found to occur in the same geological horizon as the original French types.

The test is thick and sub-spheroidal, with a flat base, and a depressed summit (Pl. III, fig. 6 *c*); the ambulacral areas are narrow, slightly sinuous in young shells, but much more markedly so in large specimens; their bases are a little expanded, to give space to the four or five pairs of semi-tubercles (fig. 6 *b*), which gradually increase in size from the peristome to the last pair; the upper portions of the areas are provided with two marginal rows of small tubercles (fig. 6 *a*), set tolerably wide apart, and alternating with each other; two rows of close-set miliary granules occupy the middle of the area (fig. 6 *d*), and circlets of the same surround the small marginal tubercles; on the upper part of the areas two rows of marginal granules alone fill up the entire areal space (fig. 6 *e*); the poriferous

zones (fig. 6 *d*) are narrow; the pairs of pores are placed obliquely upwards and outwards; between each pair there is a small elevated granule; these interporous granules form a moniliform undulated line, which marks the course of the zones.

The inter-ambulacral areas are very regularly formed, they are three times the width of the ambulacral areas, and occupied by two rows of primary tubercles, from six to seven in each row, which increase very regularly in size from the peristome to the equator, and diminish in like manner as they approach the apical disc; the areolas are large and circular; those of the five or six lower tubercles are confluent above and below, one row of miliary granules forms a series of crescents, which surround their inner margin, separating them from the poriferous zones, and two rows of the same-sized granules form a narrow zigzag inter-tubercular space down the middle of the areas; the two uppermost plates of the tubercular columns have the small tubercles they develop, alone surrounded by a distinct and continuous circle of scrobicular granules; the three largest areolas are channeled at their circumference; the mamillary bosses have a wide base, and are very prominent; their summits are deeply crenulated; the tubercles are moderately large; they have a short stem, and are deeply perforated.

The apical disc (fig. 6 *f*) is large and prominent; the antero-lateral genital plates are much the largest; the postero-lateral are longer and narrower, and the single posterior plate is the smallest and narrowest; the right antero-lateral plate, as usual, supports a conspicuous madreporiform body; the eye plates are heart-shaped, and nearly all of the same size, and the whole of the elements of the disc are covered with small close-set miliary granules; the anal opening is large, and widest in its transverse diameter.

The base is flat, and the mouth-opening (fig. 6 *b*), especially in the larger specimens, is very wide, being rather more than half the diameter of the test; the lobes of the peristome are nearly equal in size, those of the ambulacral being a little larger than those of the inter-ambulacral areas.

Affinities and differences.—*Hemicidaris Luciensis* very much resembles *Hemicidaris Wrightii*, Desor, but it is distinguished from that species by having less prominent ambulacra, without the rows of granules which fill up the area in that form. Like as in *Hemicidaris Wrightii*, the apical disc is very prominent, and the surface of the plates is covered with numerous granules.

Hemicidaris Luciensis is distinguished from *Hemicidaris Bravenderi* by having less prominent marginal granules in the ambulacra, a smaller and more prominent apical disc; the mouth opening is more unequally lobed; and it is altogether a smaller and more depressed form. Although the critical distinction between these Bathonian species is sufficiently clear, still they have so many affinities in common, that unless the specimens are well preserved, and the determination is carefully made, they may be readily mistaken for each other.

Locality and Stratigraphical position.—This species has been collected from the Great Oolite of Minchinhampton. Many small specimens are found in the Oolitic shelly beds, but they are not well preserved. One or two specimens in good preservation have been found in a Clay seam of the same rock. In France it has been collected from the Bathonien “Calcaire à polypiers,” 11th Étage, d’Orbigny (Great Oolite of English authors), at Luc, Langrune, Ranville, Calvados.

History.—M. d’Orbigny, in 1847, separated this urchin from *Hemicidaris crenularis*, with which, he says, he was confounded by M. Agassiz. He further observes, it is easily distinguished from *Hemicidaris crenularis* by a much greater number of small tubercles between the large inter-ambulacral tubercles; but this is clearly a mistake, for both species have two rows of close-set granules down the centro-sutural line. The difference resides more in the structure of the ambulacra, and in the size and prominence of the apical disc, than in the number and arrangement of the inter-ambulacral granules. It is now figured and described for the first time.

HEMICIDARIS MINOR, *Agassiz*. Pl. III, fig. 5 *a, b, c, d*.

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| HEMICIDARIS MINOR. | Agassiz, Catalogus Systematicus, p. 9. |
| — — | Agassiz and Desor, Catalogue raisonné des Échinides, Annales des Sciences Naturelles, tom. vi, p. 339, 3d series. |
| ACROSALLENIA RARISPINA. | M’Coy, Annals of Natural History, 2d series, vol. ii, p. 411. |
| HEMICIDARIS MINOR. | Wright, Annals of Natural History, 2d series, vol. xiii, pl. 2, fig. 3 <i>a—c</i> , p. 165. |
| — — | Desor, Synopsis des Échinides Fossiles, p. 56. |
| — — | Morris, Catalogue Brit. Foss. 2d edit., additional species of Echinodermata. |

Test hemispherical above, flat at the base; ambulacral areas slightly flexuous, not prominent, with six large semi-tubercles at the base, and four rows of small, unequal-sized granules in the middle, diminishing to two rows in the upper part of the areas; inter-ambulacral areas three times the width of the ambulacral, with three primary tubercles on the upper surface, and three smaller ones at the base; the wide miliary zones are covered with small, distinct, nearly equal-sized miliary granules, which form complete circles around the margins of the areolas of the primary tubercles; the apical disc is of moderate size, and its ovarial plates are covered with a delicate granulation; base flat, mouth opening large, peristome unequally decagonal, pores arranged in the zones in single pairs throughout.

Dimensions.—Height, three tenths of an inch; transverse diameter, nine twentieths of an inch.

Description.—This beautiful little urchin was first discovered in the Étage Bathonien of Langrune, Calvados, the true equivalent of the Great Oolite of English geologists. It was entered in M. Agassiz's 'Catalogus Systematicus'* as *Hemicidaris minor*, from specimens sent to him by M. Michelin. It afterwards found a place in the 'Catalogue raisonné des Échinides' of Agassiz and Desor, accompanied with this remark: "Se distingue entre tous les Hemicidaris par les tubercules très espacés, dont il n'y a que deux ou trois dans une rangée. Terrain Jurassique de France."—*Michelin*. Professor M'Coy, in his paper 'On some new Mesozoic Radiata,'† afterwards described this urchin under the name *Acrosalenia rarispina*, giving the Great Oolite of Minchinhampton for its locality.

As that gentleman has kindly favoured me with pen-and-ink sketches of the species described as new in his paper, I have no difficulty in deciding on the identity of his specimen. Moreover, I have ascertained the collection from whence it originally came. The error committed by this author in the genus must have arisen from the disc in his urchin having been covered with "adhering siliceous matrix," and from his having overlooked the very remarkable character pointed out by Agassiz, "les tubercules très espacés."

I have been fortunate enough, through the kindness of my friend Prof. Deslongchamps, to receive a typical specimen of the original species from the Great Oolite of Langrune, which I have compared with specimens obtained from the same locality as that whence Professor M'Coy's was collected, and there is not a shadow of a doubt about their perfect identity. This pretty little *Hemicidaris* is very distinct from all others of the group to which it belongs. The test is nearly hemispherical (fig. 5 *a*), and the few primary tubercles stand prominently, at great distances apart from the surface of the test. The narrow ambulacral areas are slightly flexuous above, and have from four to six semi-tubercles at their base; the sides and upper part of the areas having first four (fig. 5 *c*), and then two rows of small, imperforate granules upon their surface, about equal in size to the granulation which covers other parts of the test.

The poriferous zones are depressed, and the pedal pores disposed in pairs throughout (fig. 5 *c*); there are twelve pairs of pores opposite each of the large tubercular plates. The inter-ambulacral areas depart considerably from the typical structure of this portion of the test in the *Hemicidaridæ* (fig. 5 *a*); they are three times the width of the ambulacra, and have at their base three large primary tubercles, two on one side and one on the other, with a smaller tubercle above the single large one (fig. 5 *b*); on the sides and upper part of the areas there are only three primary tubercles, two on one side and one on the other, making only three pairs of primary tubercles in the inter-ambulacral areas, those of the base being closely set together, and those on the sides at great distances apart (fig. 5 *a, b*); the tubercles are large and hemispherical, and only slightly perforated (fig. 5 *c*); the mammillary eminences which support them are small and ring-like, (fig. 5 *a*),

* 'Catalogus Systematicus Ectyporum Echinoderm. Foss. Mus. Neocomensis,' 1840.

† 'Annals of Natural History,' 2d series, vol. ii, p. 411.

with faintly marked crenulations; the areolas are rather wide, and only slightly grooved, so that the tubercles project prominently and abruptly from the surface of the test. The margin of the areola is encircled by a row of thirteen granules (fig. 5 *c, d*), rather larger than those which cover the rest of the inter-tubercular surface of the plates. The miliary granules are close-set, and disposed without much regularity on the surface of the plates. The apical disc (fig. 5 *b*) is of moderate size, and slightly prominent; the five ovarial plates are large, and of a heptagonal form; the ocular plates are small and heart-shaped, and the surface of both is covered with a close-set, delicate granulation; the anal opening is nearly central, and circular; the base is flat; the mouth opening is large and widely decagonal, from the great size of the ambulacral lobes, and the comparative smallness of the inter-ambulacral. The spines are as yet unknown.

Affinities and differences.—This remarkable little urchin is so entirely different from its congeners, that it is impossible to mistake it for any other of the group to which it belongs. The presence of semi-tubercles at the base of the ambulacral areas only, and of granules on the sides of these spaces, associate it with *Hemicidaris diademata*, but the small number of the primary tubercles on the inter-ambulacral areas, added to the great distance at which they are placed apart, serve to distinguish it from the young of that species; in fact, these characters alone are perfectly diagnostic of *Hemicidaris minor* among all other forms of *Hemicidaris*.

Locality and Stratigraphical position.—It was first found in the “Grand Oolite” of Langrune, Calvados, whence the beautiful specimen before me was obtained, and kindly sent by Professor Deslongchamps, of Caen. I take the present opportunity of recording my grateful acknowledgements to that eminent naturalist for his kindness and courtesy, not only in contributing specimens to my cabinet for comparison and reference, but likewise for communicating many rare species of Oolitic Echinidæ, which served as the types of several of M. Agassiz’s new species, and which specimens have been of much service to me in clearing up doubts as to the identity of some other English forms.

Hemicidaris minor was collected in this country by W. Walton, Esq., from the Great Oolite of Hampton, near Bath. I have never found this species in the Great Oolite of Minchinhampton, nor have I seen it in any collection of fossils from that locality.

History.—First named by M. Agassiz from specimens in Professor Deslongchamps and M. Michelin’s collections; afterwards described as *Acrosalenia rarispina* by Professor M’Coy, from specimens in the Cambridge Museum, which came from Mr. Walton’s series, collected near Bath. It was figured and described in detail, for the first time, in my contributions to the Palæontology of Gloucestershire, published in the ‘Annals and Magazine of Natural History’ for 1854.

HEMICIDARIS RAMSAYII, *Wright*, nov. sp. Pl. VIII, fig. 6 *a*, *b*, *c*, *d*, *e*.

Test small, circular, much depressed. Ambulacra expanded below, to enclose six large semi-tubercles; very narrow and flexuous above, with two rows of small imperforate granules placed alternately on the margins thereof, and forming a single row only above. Poriferous zones narrow; pores set obliquely in pairs, with a prominent elevation of the septa. Inter-ambulacra wide, with two rows of very large tubercles, four or five in each row. Apical disc large and prominent; the genital plates with a depression near their centre; mouth opening large; peristome decagonal, with unequal-sized lobes.

Dimensions.—Height, one fifth of an inch; transverse diameter, two fifths of an inch.

Description.—This is the smallest, but certainly not one of the least interesting of the genus to which it belongs. It is remarkable for the disproportionate magnitude of three of the primary inter-ambulacral tubercles to the smallness of the test that supports them; the size and prominence of the elements of the apical disc; and the altitude being only one half the latitude of the test. These three characters readily distinguish this little gem from all its other congeners.

The ambulacral areas are wide, and expanded below, to enclose from six to eight semi-tubercles (Pl. VIII, fig. 6 *d*), which are nearly as large as the inter-ambulacral tubercles in the same region of the test; they increase gradually in size, from below upwards, the two superior pairs being the largest; above the semi-tubercles the area suddenly contracts (fig. 6 *d*), and becomes flexuous above; on its margins there are two rows of small imperforate granules, which, from the extreme narrowness of the area above, form only a single row as they approach the apical disc; the poriferous zones are narrow; the pores are set obliquely in pairs; and the thick septum forms a prominent granule, which separates the two pores forming a pair; there are seven pairs of pores, opposite one of the large inter-ambulacral plates.

The wide inter-ambulacral areas are almost entirely occupied by the two rows of primary tubercles, which, in this species, are much larger in proportion to the size of the test than in any other urchin. There are four or five plates in each inter-ambulacral column; almost the entire surface of the plate is occupied by the base of the large prominent boss (fig. 6 *d*), the summit of which is sculptured with fine crenulations; the tubercles are very large, especially the two at the circumference, and one in each area above them (fig. 6 *b*); on the upper part of these there is one small tubercle, near the circumference of the apical disc; a double row of small granules extends down the middle of the area, which sends short branches off at right angles, by which the areas are

separated from each other (fig. 6 *d*) ; but there are no granules between the boss and the poriferous zone (fig. 6 *d*).

The apical disc is large, and beautifully preserved in one of the two specimens before me ; it forms a considerable prominence on the upper surface of the test (fig. 6 *b*) ; the genital plates have a heptagonal form, are very thick, and have a remarkable depression near their centre, at the bottom of which the oviductal tubes appear to open (fig. 6 *e*) ; the anterior pair of plates are the largest, the posterior pair are rather smaller, and the single plate is the smallest ; the right antero-lateral, carrying a small madreporiform body in its depression, is the largest of the series ; the ocular plates are small heart-shaped bodies ; the vent is slightly pentagonal, excentral, and posterior.

The mouth opening is one half the diameter of the test, it has a decagonal form, and the peristome is slightly notched ; the ambulacral lobes are larger than the inter-ambulacral ; the base is flat, and the tubercles of both areas on this region of the test are nearly all of the same size (fig. 6 *c*) ; the different appearance which the test presents when viewed on its under surface (fig. 6 *c*), and on its upper surface (fig. 6 *b*), is very marked indeed.

Affinities and differences.—The only *Hemicidaris* this little form can possibly be mistaken for is *Hemicidaris minor* (Pl. III, fig. 5), with which it is associated in the same bed and locality ; but it is readily distinguished from that species by its depressed form, and by the inter-ambulacral areas being crowded with large prominent tubercles, raised on very prominent bosses ; the ambulacral areas are likewise much narrower above, and the space for the semi-tubercles is much wider below ; in fact, the remoteness of the tubercles from each other in *Hemicidaris minor*, is as good a diagnostic character of that species, as the disproportionate largeness of the tubercles, and their consequent crowding near the circumference of the test, is of *Hemicidaris Ramsayii*.

Locality and Stratigraphical position.—This rare little urchin was collected from the shelly ferruginous beds of the Great Oolite, at Sham Castle, near Bath, associated with *Hemicidaris minor*, *Acrosalenia spinosa*, and other Great Oolite forms. I dedicate this species to my friend, Professor Andrew C. Ramsay, F.R.S., Director of the Geological Survey of Great Britain.

HEMICIDARIS BRAVENDERI, *Wright*, nov. sp. Pl. V, fig. 1 *a, b, c, d, e, f*. Pl. XI, fig. 3 *a, b, c*.

CIDARIS CRENULARIS. Murchison, *Geology of Cheltenham*, 2d edit., Buckman and Strickland, pl. 13, p. 73.

Test sub-globular, flattened at the base ; ambulacral areas nearly straight, with two marginal rows of minute, well spaced out, perforated tubercles, and six pairs of moderate sized semi-tubercles ; inter-ambulacral areas with two rows of moderate sized primary

tubercles, eight in each row, gradually decreasing in size from the equator to both poles; apical disc large, anal opening excentral behind; mouth opening large; peristome divided into ten nearly equal sized lobes.

Dimensions.—Height, nine tenths of an inch; transverse diameter, one inch and one fifth of an inch.

Description.—It is exceedingly difficult to detect on the test alone of many allied species of *Hemicidaris*, characters sufficiently well marked to distinguish them from each other. When these forms, however, are found with their spines, the distinction is in general so evident, that the difficulty at once disappears; but when deprived of these appendages, the diagnosis becomes obscure. This is well exemplified in several species, and strikingly so in the one now under consideration. At the first glance *Hemicidaris Bravenderi* would be taken by most persons for *Hemicidaris intermedia*; but the details of its structure afford sufficient evidence of its distinctness from that Corallian type. The test is sub-globular, not much inflated at the base; the ambulacral areas are nearly straight, being only slightly undulated in the upper third; on the margin of the areas there are two rows of small perforated tubercles, from fifteen to sixteen in each row; raised on small bosses, and placed rather widely apart; two rows of microscopic miliary granules extend down the centre of the areas, and lateral branches form circlets around the areolas (fig. 1 *c*); the semi-tubercles are not large, but are regular as to form, size, and arrangement, the six pairs gradually decreasing in magnitude from the upper or largest pair, to the smallest or most inferior pair, which extend to the margin of the ambulacral lobe (fig. 1 *b*).

The inter-ambulacral areas (fig. 1 *b*), are nearly three and a half times the width of the ambulacral areas; their two rows of primary tubercles decrease gradually in size from the equator, where they are largest, to both poles; there are seven tubercles in each row; the bosses (fig. 1 *b*, *c*, *d*) are prominent, and their summits have from fourteen to sixteen crenulations, not, however, deeply marked; the spinigerous tubercle is small, and finely perforated; the areolas are wide and confluent (fig. 1 *c*) above and below; down the centre of the area (fig. 1 *a*, *b*) a zig-zag double row of small tubercles, slightly perforated, and raised on little eminences (fig. 1 *c*), separates the two rows of primary tubercles from each other; small miliary granules fill up the interspaces at the base of these elevations; a single row of the same sized small, perforated tubercles separates the areolas from the poriferous zones (fig. 1 *c*); among these, likewise, a few miliary granules are irregularly distributed.

The base is flat (fig. 1 *b*), and nearly two thirds of the whole is occupied by the mouth opening, which is more than one half the diameter of the shell at the equator; the peristome is deeply notched, and divided into ten nearly equal sized lobes (fig. 1 *e*), and the margin of the notches is reflexed.

The apical disc (fig. 1*f*) is large; the antero-lateral ovarian plates are the largest, and the surface of the right plate is entirely covered by the madreporiform body; the postero-lateral plates are smaller, and the right is smaller than the left plate; the odd genital plate is the smallest, and the surface of all the plates is slightly roughened, with small imperfectly developed miliary granules; the genital holes are situated near the apices of the plates (fig. 1*f*); the ocular plates are small, heart-shaped, and convex, and form a very inconsiderable portion of the disc; they likewise are covered with numerous small miliary granules; the anal opening (fig. 1*a, f*) is large, circular, and slightly excentral.

The test of *Hemicidaris Bravenderi*, on the slab (Pl. XI, fig. 3*a*), measures one inch and one fifth, and the longest spine measures three inches in length; the head is small and conical; the milled ring is narrow, and not very prominent; immediately above the ring there is a smooth, narrow, slightly depressed neck, not broader than the thickness of the milled ring; the stem is slender in proportion to its length, and preserves a very uniform diameter throughout, tapering very gently to the point; the spines of *Hemicidaris Bravenderi* differ from those of *Hemicidaris intermedia*, (Pl. IV, fig. 1) in the following details:—the spine is longer in proportion to the diameter of the test; the head is smaller; the milled ring is narrower, and less prominent; the neck is smooth and slightly contracted, instead of having a thick prominent second ring, as in *Hemicidaris intermedia*; (Pl. IV, fig. 1*n, o*) the diameter of the spine is less at the base, and more uniform, tapering less than the spine of *Hemicidaris intermedia*. In fact, the specific distinction between these closely allied species is admirably shown in the spines alone, when the two specimens, figured in Plate IV and Plate XI, are placed side by side.

Affinities and differences.—It requires a minute and careful comparison of the tests to distinguish the differences between *Hemicidaris Bravenderi* and *Hemicidaris intermedia*. In *Hemicidaris Bravenderi* the ambulacral areas are straighter, the marginal tubercles are smaller and fewer, being situated at a greater distance from each other; the semi-tubercles are likewise smaller, and not so conspicuous; the primary tubercles have lower bosses, less deeply crenulated at the summit, and the spinigerous tubercles are much smaller; the apical disc is proportionately larger, and the inequality of size between the antero-lateral and postero-lateral genital plates occasions a slight excentricity in the anal opening, not observable in *Hemicidaris intermedia* (Pl. IV, fig. 1*a, g*); the lower part of the test is likewise less inflated than in *Hemicidaris intermedia* (Pl. IV, fig. 1*c*); it is altogether a smaller form, with less prominent primary tubercles, semi-tubercles, and minute tubercles, than those which adorn the shell of *Hemicidaris intermedia*. From *Hemicidaris Luciensis* (Pl. III, fig. 6) it is distinguished by having the test more globose, with straighter and wider ambulacral areas, and smaller semi-tubercles; the apical disc is not so convex and prominent; the mouth opening is larger, and its peristome is likewise divided into more nearly equal-sized lobes. The absence of primary tubercles from the upper parts of the inter-

ambulacral areas in *Hemicidaris pustulosa* (Pl. III, fig. 1) and *Hemicidaris granulosa* (Pl. III, fig. 2) distinguish at a glance these species from *Hemicidaris Bravenderi*.

In its sub-globose form it much resembles *Hemicidaris Davidsoni* (Pl. IV, fig. 2), but it is distinguished from that Portland species in having wider ambulacral areas, with the minute tubercles thereon both longitudinally and laterally more widely apart; the semi-tubercles are likewise much smaller, and disposed regularly in pairs, whereas they run (in many specimens) into a single row in *Hemicidaris Davidsoni* (Pl. IV, fig. 2 *b, c*). The size of the anal opening in the latter is much greater, so much so, that the right postero-lateral and odd genital plates are greatly reduced in size. *Hemicidaris Bravenderi* resembles *Hemicidaris Purbeckensis* (Pl. V, fig. 4) in the straightness of the ambulacral areas, but these divisions of the shell are wider, and the minute marginal tubercles are set wider apart in the former species; the semi-tubercles, likewise, are more regularly disposed in pairs than in the Purbeck form (Pl. IV, fig. 4 *b*), where they assume a linear arrangement. The sudden diminution in the size of the primary tubercles on the upper parts of the inter-ambulacral areas in *Hemicidaris Stokesii* (Pl. III, fig. 3) at once separates that Stonesfield slate species from *Hemicidaris Bravenderi*.

Locality and Stratigraphical position.—This species belongs to the Bathonian Oolitic zone. It has been collected from the Great Oolite of Kill-Devil Hill, near Cirencester, by Mr. J. Brown of that town, but the specimen, formerly in the collection of that gentleman, now presented to the British Museum, is unfortunately not well conserved. Mr. Bravender, F.G.S., of Cirencester, found a fine specimen of this species, with its spines attached, in the Great Oolite at Stratton, near Cirencester, which was figured by Mr. Buckman in the ‘Geology of Cheltenham.’ Its zoological characters are very well preserved. This species was collected by Mr. Bristow, of the Geological Survey, from the Cornbrash, in a lane leading from Stourton Caundle to Lower Woodacre. This fine specimen is in the Museum of Practical Geology, Jermyn Street, and has been admirably figured by Mr. Bone for this Monograph. *Hemicidaris Bravenderi* is found, likewise, in the Great Oolite of Langrune, Calvados. I have specimens from that locality kindly sent me by Professor Deslongchamps and M. Tesson, of Caen.

History.—First figured, without description, as *Hemicidaris crenularis* in the ‘Geology of Cheltenham,’ and noticed by Professor Forbes in his Note on the species of *Hemicidaris* found in British strata, ‘Memoir of the Geological Survey,’ Decade III: “This fine species,” he observes, “is very distinct from any other British one, resembling most nearly *Hemicidaris intermedia*, but differing in having gradually, not suddenly, increasing ambulacral areas, with the tubercles upon them set well apart, except below, where the larger ones are closely packed. Until the spines shall have been discovered, I hesitate to give a name to this form, since it so closely agrees with the figure of the Swiss species, *Hemicidaris crenularis*.” The detailed diagnosis of the points of difference between

Hemicidaris Bravenderi and *Hemicidaris intermedia* apply with equal truth as between our species and *Hemicidaris crenularis*, which differs from *Hemicidaris intermedia* chiefly in the form of its spines. The test is now figured in detail and described for the first time. I dedicate the species to Mr. Bravender, F.G.S., of Cirencester, who first found this urchin in 1844, at Stratton, near Cirencester, and to whom I am indebted for the loan of the original specimen with spines, figured in Pl. XI, fig. 3.

HEMICIDARIS WRIGHTII, Desor. Pl. V, fig. 2 *a, b, c, d, e.*

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| HEMICIDARIS ALPINA. | Wright, on the Cidaridæ of the Oolites, Annals and Magazine of Natural History, 2d series, vol. viii, p. 256, pl. 11, fig. 3 <i>a, b.</i> |
| — — | Forbes, Memoirs of the Geological Survey, Decade III, pl. 5. Notes on British Species of Hemicidaris. |
| — — | Morris, Catalogue of British Fossils, 2d ed., 1854, p. 81. |
| — WRIGHTII. | Desor, Synopsis des Échinides Fossiles, p. 54. |

Test sub-globose, depressed above; ambulacral areas prominent, convex, and slightly flexuous, crowded with four rows of small miliary granules on the sides, and four semi-tubercles at the base; primary tubercles of the inter-ambulacral areas suddenly diminishing in size above; apical disc large, prominent, and convex.

Dimensions.—Height, nearly three fifths of an inch; transverse diameter, nine tenths of an inch.

Description.—When this beautiful urchin was discovered some years ago, I provisionally identified it with *Hemicidaris alpina*, Agassiz, from the peculiar structure of the ambulacral areas. Finding that my friend Mr. S. P. Woodward had made a like determination of a specimen contained in the collection of Mr. Lowe, and obtained from the same locality, I figured and described it as *Hemicidaris alpina*, with this remark: "I consider my urchin, however, merely a variety of the Swiss species, for which I propose the name variety *granularis*." My late lamented friend, Professor Edward Forbes, had formed a similar conclusion from the specimens he examined, for he observes, in his notes on the species of Hemicidaris found in British strata, *Hemicidaris alpina*, Agassiz—"A pretty species, easily distinguished from its congeners by the very small and thickly-set ambulacral tubercles." M. Desor's knowledge of the type of *Hemicidaris alpina*, Agassiz, enabled him to point out the distinctive characters between that species and our urchin. He says—"Hemicidaris Wrightii, Desor. Syn. *Hemicidaris alpina*, var. *granularis*, Wright. Les ambulacres sont plus saillants et moins larges que dans le *Hemicidaris alpina*; leur rangées externes de granules sont moins accusées. Sur contre il existe à l'intérieur de ces granules marginales quatre à six rangées de très fines granelures

comme dans l'espèce précédente. Les tubercules inter-ambulacraires diminuent sensiblement de grosseur à la face supérieure.”* The *Hemicidaris alpina*, Agassiz, was collected from the upper division of the Jurassic group, “Portlandien moyen (Kimméridgien) de Gesné et des Ormonds (Alpes vaudoises),” whilst *Hemicidaris Wrightii* was found in the lower division of the same group, the Bradford Clay and Forest Marble.

The test of this beautiful species is sub-globose; the ambulacral areas are slightly undulated, and of a medium size, rather depressed above; they are prominent and convex, of an elongated conical form, and are thickly covered with small hemispherical granules, without perforations or other sculpture (Pl. V, fig. 2 *d*); the marginal rows are larger and more regular; between them are from four to six rows of smaller granules, closely set together. At the base of the areas are four or six mammillated and perforated semi-tubercles (Pl. V, fig. 2 *e*), which are limited to this region. The pores are set obliquely in pairs, with a smooth, elevated granule between each pair, which forms a moniliform sinuous line, running between the pores (Pl. V, fig. 2 *d*).

The inter-ambulacral areas are of moderate breadth, with two rows of primary tubercles, five or six on each column. The bosses of the two central tubercles are large and prominent (Pl. V, fig. 2 *f*); those towards the anal and oral poles are smaller (fig. 2 *a*), and they are all crenulated at their summits (fig. 2 *f*); the tubercles are deeply perforated, and supported on a short stem, the hemispherical head of the tubercle not exceeding in diameter that of the stem (fig. 2 *f*); the areolas around the basis are slightly channeled, and they are all confluent; those towards the anal pole have a circle of granules encircling the areolas (fig. 2 *a*); the miliary zones are narrow, and covered with two rows of small, smooth granules (fig. 2 *b*), similar in form and size to those occupying the ambulacral areas. The apical disc (fig. 2 *a* and *c*) is very prominent; the ovarian plates are large, convex, and much granulated; the two anterior pair are larger than the posterior pair, but the right anterior plate is the largest (fig. 2 *c*); the genital holes are large, and near the apices; the ocular plates are of a proportionate size; the spines are unknown.

The mouth opening is of moderate size, the peristome between the lobes being deeply notched and reflexed; the pores are small, and separated by thick septa (fig. 2 *d*); they are disposed in simple pairs nearly all the length of the poriferous zones, but are arranged in double files around the border of the oral aperture, in such a manner as to occupy all the free space in the ambulacral areas, resulting from the contraction of the inter-ambulacral areas in the region of the mouth; the surface of the septa develops prominent convex elevations, which form a moniliform line separating the pores of each zone.

Affinities and differences.—Our specimen is smaller in size, but, with the differences already pointed out, it much resembles *Hemicidaris Alpina*, Agassiz, from the Calcaire de Saanen, in having the ambulacral areas closely crowded with small, uniform, and hemi-

* ‘Synopsis des Échinides Fossiles,’ p. 54.

spherical miliary granules; the areas, however, are more prominent and convex, and want the defined rows of marginal granules which characterise the Swiss specimen. It very much resembles *Hemicidaris Luciensis*, d'Orbigny; but the four rows of nearly equal-sized granules filling the ambulacral areas serve to distinguish it from that species.

Locality and Stratigraphical position.—This species was collected from the Bradford Clay of Pickwick, Wilts. A valve of *Terebratula digona* was attached to the test, and the specimen is firmly adherent to the surface of *Rhynchonella concinna*. In Mr. Lowe's cabinet there is a fine specimen of this urchin, which was collected at Pickwick; and in the British Museum there is another good specimen, likewise from Wiltshire. Separate plates of this *Hemicidaris* have been found in the Bradford Clay at the Tetbury-road Station of the Great Western Railway. It is, however, a rare species.

History.—First figured and described in my 'Memoir on the Cidaridæ of the Oolites,' afterwards included in Professor Forbes's descriptions of Jurassic *Hemicidaris*, in the 'Memoirs of the Geological Survey of Great Britain,' Decade III; entered in the second edition of Professor Morris's 'Catalogue;' lastly, separated from *Hemicidaris alpina* by M. Desor in his 'Synopsis des Échinides Fossiles.'

HEMICIDARIS ICAUNENSIS, *Cotteau*. Pl. III, fig. 4 *a, b*.

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| HEMICIDARIS ICAUNENSIS. | Cotteau, Études sur les Échinides Fossiles, p. 56, pl. 3, figs. 1—3. |
| — | Forbes, Memoirs of the Geological Survey, Decade III. Notes on <i>Hemicidaris</i> . |
| — | Wright, on the Cidaridæ of the Oolites, Annals and Magazine of Natural History, 2d series, vol. viii, p. 256, pl. 11, fig. 3 <i>a, b</i> . |
| — | Morris, Catalogue of British Fossils, p. 82, 2d edit. |
| — | Desor, Synopsis des Échinides Fossiles, p. 53. |

Test hemispherical, inflated, and slightly depressed; ambulacral areas with two rows of small marginal tubercles, and with three or four pairs of semi-tubercles at the base; inter-ambulacral areas with two ranges of primary tubercles; mouth large and decagonal; margin deeply notched.

Dimensions.—Height, four fifths of an inch; transverse diameter, one inch and one fifth.

Description.—This species is hemispherical and inflated at the sides, and its transverse diameter is one half more than its height. The inter-ambulacral areas are furnished with two rows of large primary tubercles; in each range there are from six to seven tubercles,

which attain their greatest development at the equator of the test, and diminish in size near the anal and buccal openings. The mammillary eminences supporting the tubercles are large, prominent, and surrounded by confluent areolas. The tubercles are small and perforated; one row of granules separates the large tubercles from the poriferous zones, and a double row occupies the middle of the area. The lateral boundaries of the areolas are surrounded by semicircles of granules, whilst the upper and lower boundaries of the same blend into each other.

The ambulacral areas are narrow, slightly undulated, and furnished through nearly all their extent with a double row of small tubercles, which are not very apparent, but are larger on the sides than at the apex of the area; between the size of these and the three pairs of semi-tubercles at the base, a sensible difference exists. The mouth opening is large, and is one half the diameter of the test; it is of a decagonal form, with the peristome deeply notched. The apical disc is not preserved, and the spines are unknown.

Affinities and differences.—*Hemicidaris icaunensis*, in its general form and characters, closely resembles *Hemicidaris intermedia*. It is distinguished from the latter by having the primary tubercles of the inter-ambulacral areas less prominent, by the ambulacral areas being less waved, and in having the semi-tubercles much smaller. This character assimilates *Hemicidaris icaunensis* with *Hemicidaris Thurmanni*, but it is sufficiently distinguished from that urchin by its greater height, less undulated ambulacra, and the greater number of tubercular plates in the inter-ambulacral areas.

Locality and Stratigraphical position.—This rare species was obtained by Mr. Lycett from the Great Oolite of Minchinhampton. M. Cotteau collected it in France from the superior beds of the Bathonian stage at Châtel-Censoir; and M. Bathier found it in the Forest Marble of Châtel-Gérard, where it is likewise rare.

History.—This species was first figured and described by M. Cotteau,* and was provisionally identified by Professor Forbes.† It is figured in Pl. A, fig. 9, of the ‘Monograph of Great Oolite Fossils,’ to be published by the Palæontographical Society. The specimen before me, which belongs to Mr. Lycett’s collection, is only a cast; the determination, therefore, is doubtful, but as it was made by my lamented friend, after a careful consideration of the facts, I have adopted his views without vouching for their accuracy. The specimen is so imperfect, that I have followed M. Cotteau’s description.

* Échinides Foss. du Département de l’Yonne, t. 3, p. 56.

† Memoirs of the Geological Survey; Brit. Organic Remains, Decade III, description of pl. 5.

HEMICIDARIS CONFLUENS, *M'Coy*.

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| HEMICIDARIS CONFLUENS. | M'Coy, Annals and Magazine of Natural History, vol. ii, new series, p. 411. |
| — — | Forbes, Memoirs of the Geological Survey, Decade V, Notes on Hemicidaridæ. |
| — — | Morris, Catalogue of British Fossils, 2d edition, 1854, p. 82. |
| — — | Wright, On the Cidaridæ of the Oolites, Annals and Magazine of Natural History, 2d series, vol. viii, p. 258. |

Through the kindness of Professor Sedgwick, I have been enabled to examine the type specimen of this urchin, which forms part of the geological collection of the University of Cambridge. It proves to be a bad specimen of an *Acrosalenia*, with the test so much defaced as to be specifically indeterminable. It unquestionably was collected from the shelly beds of the Great Oolite of Minchinhampton. This species must now therefore be omitted from the list of Hemicidaridæ.

C. *Species from the Coralline Oolite, including the Calcareous Grit.*—14th Étage, Corallien, d'Orbigny.

HEMICIDARIS INTERMEDIA, *Fleming*. Pl. IV, fig. 1 *a, b, c, d, e, f, g, h, o*.

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| CIDARIS PAPILLATA. | Var. of Parkinson, Organic Remains, vol. iii, p. 14, pl. 1, fig. 6, and pl. 4, fig. 20. |
| — INTERMEDIA. | Fleming, British Animals (1828), p. 478. |
| HEMICIDARIS CRENULARIS. | Morris, Catalogue of British Fossils (1843), p. 53. |
| HEMICIDARIS INTERMEDIA. | Forbes, Memoirs of the Geological Survey, Decade III, pl. 4. |
| — — | Wright, On the Cidaridæ of the Oolites, Annals and Magazine of Natural History, 2d series, vol. viii, p. 252. |
| — — | Desor, Synopsis des Échinides Fossiles, p. 52. |
| — — | Morris, Catalogue of British Fossils, 2d edition, 1854, p. 82. |
| CIDARIS INTERMEDIA. | Phillips, Geology of Yorkshire, p. 127. |
| — PAPILLATA. | Young and Bird, A Geological Survey of the Yorkshire Coast, pl. 4, fig. 1, p. 211. |

Test sub-globose or sub-conoidal; ambulacral areas slightly undulated above, with a double row of minute, perforated, marginal tubercles on the sides, and six pairs of semi-tubercles at the base; inter-ambulacral areas with eight pairs of primary tubercles, on large prominent bosses, having deeply crenulated summits; apical disc not prominent; anus nearly central; mouth opening large, peristome deeply notched and divided into ten unequal-sized lobes. Spines long, round, and tapering to a blunt point; surface with

fine longitudinal lines; base tumid, with a prominent milled ring below, and a second smooth ring above. Jaws large and powerful.

Dimensions.—1 *c*. Height, one inch and one tenth of an inch; transverse diameter, one inch and three fifths of an inch.

1 *i*. Height, one inch and three fifths of an inch; transverse diameter, one inch and three fifths of an inch.

Description.—This is one of the most common, and, at the same time, one of the most beautiful and typical examples of the genus *Hemicidaris* in our English rocks. Like its associate, *Cidaris florigemma*, it has long been mistaken for a foreign species (*Hemicidaris crenularis*) which has not yet been found in our Coralline Oolites.

Had the determination of this species rested on the anatomy of the shell alone, it would have been almost impossible to distinguish between these two species; but, fortunately, M. Agassiz has given a fine figure and detailed description* of *Hemicidaris crenularis* of Switzerland, said to be the type of Lamarck's species. This magnificent specimen, with its spines attached, was found in the Corallien étage of Besançon, and formed part of the collection of M. le Comte Dudressier, which Herr Suess informs me is in the Imperial Museum of Vienna. Now as Lamarck's *Cidaris crenularis* came from Switzerland ("Habite, Fossile de la Suisse"†), we cannot doubt the identity of the specimen figured by Agassiz with the Lamarckian type. These points having been settled, it is easy to show that this English *Hemicidaris* is very distinct from the Swiss one, for although the tests can only critically be distinguished from each other, still the spines of the Swiss urchin are so very different from the English form, that there cannot be a doubt about the distinctness of the species. In *Hemicidaris crenularis* the spines form large clubs, which gradually increase in diameter from the head to the extremity, whereas in *Hemicidaris intermedia* they gradually taper from the head to the point.

The first good figure of *Hemicidaris intermedia* was given by Parkinson in his 'Organic Remains,' and described as a mammillated Echinite from Wiltshire, which "should perhaps be considered a variation of *Cidaris papillata*."‡ Mantell gave a reduced copy of Agassiz's figure in his 'Medals of Creation,' vol. i, p. 340, observing, however,— "This species (*Hemicidaris crenularis*) of mammillated Echinus is common in the Oolite of this country, and is considered to be characteristic of the Upper Jura limestone; it is said to be the same as that figured by Mr. Parkinson, under the name of *Cidaris mammillata*, from Calne, in Wiltshire; but I have never observed spines like those of Agassiz's figure in the English Oolite. These spines are not homogeneous throughout, but their central part appears to have been of a softer texture than the external crust, as may be seen in the

* 'Echinodermes Fossiles de la Suisse,' seconde partie, pl. 18, figs. 23 and 24, p. 44.

† 'Histoire Naturelle des Animaux sans Vertèbres,' 2d édit. tome iii, p. 384.

‡ Parkinson, 'Organic Remains,' vol. iii, p. 14.

figure where the spines are imperfect.”* The figure given by Young and Bird of *Hemicidaris intermedia* found in the Coralline Oolite of Yorkshire is so bad, that, had I not seen the specimens said to be the type of this figure, and which were undeniable specimens, I should have hesitated before including it in the list of synonyms. The description of the species, however, by Mr. Young,† is very accurate, and is, at the same time, the first given of this species. Dr. Fleming‡ described it under the name *Cidaris intermedia*, giving, as its specific character—“Lesser compartments half the width of the larger ones; tubercles crenulated at the base:” which was rather a generic than a specific diagnosis.

Hemicidaris intermedia is sub-globose, varying from a depressed spheroid to a conoidal form (Pl. III, fig. 1 *c*, *i*); the upper surface is slightly depressed and the base is flat; the ambulacral areas are narrow, and gently undulated towards the upper part; the semi-tubercles occupy the basal third of the area; of these there are six pairs, which gradually increase in size from the peristome upwards (Pl. III, fig. 1 *b*); the two uppermost pairs are rather prominent (fig. 1 *d*); the sides of the areas support two marginal rows of minute, perforated tubercles (fig. 1 *d*), raised on small elevations—a few microscopic miliary granules separate the rows, and form semi-circlets around the base of the eminences; the poriferous zones are much undulated, especially in the upper part; the pores are in pairs throughout the zones as far down as the third pair of semi-tubercles, where they become irregular, and fall into oblique rows, having three pairs in each; five or six such oblique rows extend to the peristome, and fill up the space left by the smallness of the lower semi-tubercles. There are eleven pairs of pores opposite one of the large plates at the equator.

The inter-ambulacral areas are more than three times the width of the ambulacral, and furnished with eight pairs of large, prominent, primary tubercles (fig. 1 *c*); the mammillary bosses form prominent projecting cones (fig. 1 *e*), the areolas of which touch those of the adjoining ones in the same range; the areolated spaces of the plates in each row are therefore confluent (fig. 1 *d*); down the middle of the areas, and following the zigzag centro-sutural line, there is a conspicuous double row of small, well-marked, perforated tubercles (fig. 1 *d*), amongst which some minute miliary granules are scattered; there are seven of these small tubercles round the centro-sutural edges of each of the larger tubercular plates (fig. 1 *d*); a single row of the same sized small tubercles separates the external or zonal border of the areas from the poriferous zones, there being about six small tubercles around the edge of each large plate (fig. 1 *d*). By this arrangement the upper and lower boundaries of the areolas surrounding the bosses are confluent, whilst the outer and inner boundaries thereof are surrounded by the small tubercles described (fig. 1 *d*). The summits of the bosses are deeply sculptured with fourteen well-marked crenulations (fig. 1 *d*, *e*); the tubercles are large and deeply crenulated (fig. 1 *e*), and maintain their proportional size on the upper part of the areas (fig. 1 *a*).

* ‘Medals of Creation,’ vol. i, p. 344.

† ‘British Animals,’ p. 478.

‡ ‘A Geological Survey of the Yorkshire Coast,’ p. 211.

The apical disc is about one fourth the diameter of the test (fig. 1 *a*); the antero-lateral pairs of genital plates are the largest, the postero-lateral are smaller, and the single plate is the smallest (fig. 1 *g*); the madreporiform body occupies all the surface of the right antero-lateral plate, which is the largest; the genital holes are situated near the apices of the plates; the ocular plates are heart-shaped. They form very inconspicuous elements of the disc in this species. The eyeholes are very minute, and marginal, and situated opposite the truncated apices of the ambulacra; (fig. 1 *a*) the surface of both the genital and ocular plates is covered with numerous minute miliary granules, very irregularly arranged.

The mouth opening is wide, occupying three fifths of the under surface (fig. 1 *b*); the peristome is deeply notched, and the edge thereof is reflexed at the junction between each inter-ambulacral series and the wide part of the poriferous zones; the lobes of the peristome are of unequal size, those of the ambulacral division being nearly one third wider (fig. 1 *b*) than those of the inter-ambulacral.

The five jaws are large and powerful, and are preserved *in situ* in several specimens in my cabinet (fig. 1 *b*); each jaw has a broad, external, convex surface (fig. 1 *f*), and two lateral ridges, with intervening furrows. The jaw consists of two halves, and the symphysis extends through the middle of the central ridge.

In many specimens of this urchin the spines are admirably preserved in connection with the test (fig. 1 *h*). The primary spines are long, tapering, and nearly cylindrical. They grow in length to nearly twice the diameter of the test to which they belong, some of them measuring three inches and three quarters (fig. 1 *n*); they are closely and minutely striated in the longitudinal direction, but the striæ are rather broader than the raised interstices. The base of each spine has a narrow elevation, or second smooth ring, just above the milled ring, which is prominent, and deeply crenulated (fig. 1 *o*); the acetabulum is likewise crenulated round its rim. The secondary spines, which are attached to the minute marginal tubercles of the ambulacra, and to the tubercles of the same size in the inter-ambulacra (fig. 1 *h*, *i*), are small, compressed, and spatulate-shaped; their surface is likewise covered with longitudinal lines (fig. 1 *k*), the neck is encircled with a small milled ring, and a second smooth ring. Some of them measure one fifth of an inch in length. On some well-preserved specimens from the Clay Beds, I have occasionally observed on the surface of the test, when cleaning these specimens, small bodies resembling pedicellariæ.

Affinities and differences.—The tests of *Hemicidaris intermedia* and *Hemicidaris crenularis* resemble each other so much, that it is difficult to point out the distinction. In a fine specimen of *Hemicidaris crenularis*, from Lure Doubs, kindly sent me by M. Michelin, the base is less tumid, the minute marginal tubercles on the ambulacral areas are fewer in number and smaller, the primary tubercles of the inter-ambulacra are larger, and their areolas are wider; the mouth opening is likewise larger, and the shell is in general higher than in *Hemicidaris intermedia*. But, as I have already observed, it is in the form and structure of the spines that the true specific distinction is found.

The difference between this species and *Hemicidaris Bravenderi* has been already pointed out in the article on that urchin, and its affinities with *Hemicidaris Purbeckensis* and *Hemicidaris Davidsoni* will hereafter be discussed in the description of those species.

Locality and Stratigraphical position.—This species is sometimes very common, and found in fine preservation in the Coralline Oolite at Calne, Wilts. It is collected in the Coral Rag at Weymouth, and in the same rock near Faringdon, in Berkshire; from the Coralline Oolite of Malton, in Yorkshire, it is likewise rarely obtained. I have before me specimens from all these localities. From Hildenley, near Malton, some very fine shells have been collected, but the Yorkshire specimens in general are not well preserved.

History.—This, in all probability, is the urchin which was figured by Martin Lister* and by Plott,† and has been always a much admired and abundant Echinite. Until separated by Dr. Fleming under the name *Hemicidaris intermedia*, it was confounded with *Hemicidaris crenularis* of continental authors; and I have good reasons for believing that it is often mistaken for that species by foreign palæontologists, as I have received specimens ticketed *Hemicidaris crenularis* which undoubtedly belong to the English species. In *Hemicidaris intermedia* the base is always much more inflated than the same region of the test in *Hemicidaris crenularis*, which tapers more, and gives the shell a more globular and elegant form. Compare, for example, our figures with the excellent drawings of *Hemicidaris crenularis*, given in Goldfuss's 'Petrefacta Germaniæ.'

D. *Species from the Portland Oolite.*—16th Etage Portlandien, d'Orbigny.

HEMICIDARIS DAVIDSONI, *Wright*, nov. species. Pl. IV, fig. 2 *a, b, c, d.*

Test subglobose; ambulacral areas slightly undulated, upper half with two rows of minute marginal tubercles, lower half occupied by an irregular row of large semi-tubercles; primary tubercles of the inter-ambulacral areas well developed, and gradually diminishing in size from the equator to both poles; apical disc large, genital plates of unequal size; anal opening large and excentral; mouth opening large; peristome notched into nearly equal-sized lobes.

Dimensions.—Height, nearly one inch; transverse diameter, one inch and three tenths of an inch.

Description.—This is the only *Hemicidaris* known from the Portland Beds, it is identical

* 'Historia Animalium Angliæ Lap. Turb.,' p. 221, pl. 7, fig. 21, 1578.

† 'Natural History of Oxfordshire.'

with one collected many years ago from the Portland Sandstone of the Boulonnais by MM. Bouchard, Chantreaux, and Davidson, and beautifully drawn by the latter gentleman in the first plate of his 'Memoir on the Fossils of the Boulonnais,' the publication of which has been delayed until the completion of his great work on British Fossil Brachiopoda for the Palæontographical Society. Mr. Davidson has kindly sent me his beautiful drawings, to make of them whatever use I may think fit; and M. Bouchard has most generously forwarded his best specimens of this species to enable me to complete its description. The organic characters of *Hemicidaris Davidsoni* are intermediate, like its stratigraphic position, between *Hemicidaris intermedia* and *Hemicidaris Purbeckensis*. The shell has a sub-globose form, slightly flattened at the poles; it is rather more tumid towards the base than above; the ambulacral areas are narrow, and slightly undulated; the base is occupied by large semi-tubercles (Pl. IV, fig. 2 *b*), which are not disposed regularly in pairs, as in *Hemicidaris intermedia* (Pl. IV, fig. 1 *c, d*); but in consequence of the narrowness of the areas in this region, the four upper semi-tubercles extend one above another, forming an irregular continuous line, ascending nearly half-way up the area (fig. 2 *b*); the upper half of which has two rows of minute perforated tubercles, raised on small eminences (fig. 2 *c*); these tubercles, about twelve in each row, alternate with each other, and are separated by a zigzag line of miliary microscopic granules. The poriferous zones form a series of crescentic waves round the ambulacral sides of the tubercular plates (fig. 2 *c*); the pores are in pairs, with a slightly elevated portion of the septum between them, and there are nine pairs of pores opposite each of the large inter-ambulacral plates; only at the base of the areas, and close to the peristome, do the pores fall into double pairs; and of these there are only two or three rows.

The inter-ambulacral areas are more than three and a half times the width of the ambulacral; there are eight primary tubercles on each of the two rows that fill this division of the test; from the equator, where they are largest, to both poles, they gradually diminish in size; the tubercles are small, and not deeply perforated; the bosses are large and prominent (fig. 2 *c*), with coarsely crenulated summits; they are surrounded by wide, smooth areolas; each tubercular plate (fig. 2 *c*) has on its zonal border, between the areola and the pores, a series of six or seven minute tubercles, raised on small eminences; and on its centro-sutural border a series of six or seven like minute tubercles, which form two lateral crescents around the base of the areola (fig. 2 *d*); the four uppermost plates have a horizontal line of smaller granules extended across their apical border (fig. 2 *a, b*), so that the primary tubercles of these upper plates have their areolas encircled by an uninterrupted series of granules; but in all the lower plates they are more or less confluent above and below (fig. 2 *e*).

The apical disc is large (fig. 2 *f*); the antero-lateral genital plates are more than twice the size of the others; the right plate is the largest, and carries a prominent convex madreporiform body; the postero-lateral and single plates are much reduced in size, in consequence of the width of the anal opening (fig. 2 *a, f*); the oviductal holes are marginal, the ocular

plates are heart-shaped; the eyeholes are small and marginal; the posterior pair extend into the anal circle in consequence of the diminution in size of the postero-lateral and single genital plates (fig. 2 *f*).

The base is flat, the mouth opening is large, and occupies three fifths of this region; the peristome is deeply notched, the lobes are nearly of equal size, and those of the ambulacral areas are the largest (fig. 2 *e*).

The primary spines are not long, rarely exceeding in length one and a half times the diameter of the test; they do not taper suddenly; the head is short; the acetabulum is small, crenulated on the rim, and surmounted by a prominent milled ring, beyond which is a second ring-like elevation; the surface of the stem is covered with very fine longitudinal lines, which are almost always effaced; the secondary spines, articulated with the minute tubercles of the ambulacra, and those surrounding the margins of the inter-ambulacral plates, are short, thorn-like processes. This description of the spines is made from French specimens.

Affinities and differences.—This urchin resembles very much *Hemicidaris Purbeckensis*, both in its general configuration and in many points of its organization; but differs from it in the manner the semi-tubercles are arranged at the base of the ambulacra, in the greater size of the apical disc and anal opening, and, above all, in the absence of the broad, crenulated band which surrounds the body of the primary spines above the milled ring.

Locality and Stratigraphical position.—The specimen figured was collected from the Portland Sand. Those found in the Boulonnais were collected from the Portland Beds of the Falaise d'Alprecht, and at Ningle, by MM. Bouchard and Davidson, where it is associated with a small elongated urchin, *Echinobrissus Haimii*, Wright, nov. sp.

E. *Species from the Marine Purbeck Beds.*

HEMICIDARIS PURBECKENSIS, *Forbes*. Pl. V, fig. 4 *a, b, c, d*.

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| HEMICIDARIS PURBECKENSIS. | Forbes, Memoirs of the Geological Survey, Decade III, pl. 5. |
| — | — Morris, British Fossils, 1854, 2 ed., p. 82. |
| — | — Desor, Synopsis des Échinides Fossiles, p. 5, pl. 11, fig. 5. |

Test sub-globose; ambulacral areas narrow and nearly straight, with five pairs of small semi-tubercles; inter-ambulacral areas with eight small tubercles set on moderate-sized bosses; apical disc composed of unequal-sized genital plates; primary spines sub-compressed, with a broad band of fine longitudinal lines at the base, above the prominent milled ring.

Dimensions.—Specimens all more or less distorted. Height, about three quarters of an inch; transverse diameter, about one inch and three tenths.

Description.—The discovery of Echinoderms in the Cinder Bed of the Purbecks was one of the rewards of the careful examination of these strata made by the officers of the Geological Survey of Great Britain. “For several days,” observed Professor Forbes,* who found the first specimen at Swanage, in Dorsetshire, “I had found spines of an urchin with which I was unacquainted among the marine fossils which occur in a zone on the summit of the well-known ‘Cinder Bed,’ composed chiefly of *Ostrea distorta*, Sow., and constituting a conspicuous stratum in the middle division of the Purbecks. A careful search, during which I was rewarded by the discovery of several new forms of marine Purbeck Mollusca, resulted in the finding of a very perfect specimen of the body of the *Hemicidaris*, now first described, accompanied by its spines, identical in structure with those previously observed.” It is this same urchin, with others since found, that my figures represent.

The body is sub-globose, but was apparently rather depressed above; the specimens being all more or less distorted, it is impossible to describe its form with accuracy.

The ambulacral areas are narrow, and only slightly undulated; there are two rows of minute perforated tubercles, on miniature bosses, on the margins, about sixteen in each row; a zigzag line of very small granules runs down the middle of the area, and sends small branches of granules to encircle each minute tubercle (fig. 4 *b*); at the base of the area there are five pairs of small semi-tubercles, which, in a small specimen before me, have a very regular arrangement but in the larger specimens are more diffusely disposed, so as to alternate with considerable interspaces. The poriferous zones are slightly undulated, the pores are small, the pairs are a little oblique, and there is a slight elevation of the test corresponding to the septa; there are about nine or ten pairs of pores opposite one of the large inter-ambulacral plates.

The inter-ambulacral areas at the equator are hardly three times the width of the ambulacral; the two rows of primary tubercles occupy the centre of the plates (fig. 1 *a*); the tubercles are small, set upon a smooth, slightly elevated boss, with a deeply crenulated summit; around the base is a smooth, well-defined, and grooved areola; the ambulacral and centro-sutural sides of the large plates are bordered by small, rounded granules (fig. 4 *b*), some of which extend between adjacent areolas in the upper part of the areas, but they are absent from the plates below when the areolas are confluent. The areola is wide in comparison with the size of the boss (fig. 4 *b*). There are about eight primary tubercles in each row, gradually increasing in size as they approach the equator.

The apical disc is moderately large (fig. 4 *a*); the antero-lateral genital plates are much the largest; the madreporiform body occupies nearly all the surface of the

* ‘Memoirs of the Geological Survey,’ Decade III, description of pl. v, p. 3.

right plate; the postero-lateral and single plates are nearly alike in size, but the single one is the smallest; all the genital holes are marginal; as the anal opening is transversely oval, and enlarged at their expense, that aperture is excentral. The ocular plates are small, heart-shaped bodies, wedged in between the truncated apices of the ambulacra and the genital plates; the eyeholes are quite marginal.

The spines (fig. 4 *c*, *d*) are sub-cylindrical, and slightly compressed on the sides; the diameter of the largest spine is about one tenth of an inch; they are all so much weathered, that the longitudinal lines on their surface cannot be seen; above the prominent milled ring (fig. 4 *c*) there is a broad, well-defined space, marked with longitudinal lines, which forms an important diagnostic mark between this species and its congeners. The articulating head is small, and the acetabulum diminutive.

In none of the specimens is the mouth opening exposed.

Affinities and differences.—*Hemicidaris Purbeckensis* differs from *Hemicidaris intermedia* in having smaller tubercles and less prominent bosses. In this respect it is allied to the *Hemicidaris Bravenderi* (Pl. V, fig. 1; Pl. XI, fig. 3); but the character of the spines, with the striated space above the milled ring, distinguishes it from both. Its closest affinity is with *Hemicidaris Davidsoni*; but from that Portland species it is distinguished by having narrower inter-ambulacral areas, smaller bosses, more confluent areolas, and above all by the comparative regularity of the semi-tubercles, which, on the contrary, extend singly up nearly half the ambulacral areas in *Hemicidaris Davidsoni* (Pl. IV, fig. 2 *b*, *c*). The apical disc is likewise much smaller, and the vent not so wide.

HEMICIDARIS STRAMONIUM, *Agassiz*.

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| HEMICIDARIS STRAMONIUM. | M'Coy, New Mesozoic Radiata, Annals and Magazine of Natural History, vol. ii, new series, p. 420. |
| — | — Forbes, Memoirs of the Geological Survey, Decade III, notes on Hemicidaris. |
| — | — Morris, British Fossils, 1854, 2 ed., p. 82. |

From the doubtful manner in which this species was quoted by Professor Forbes, in his 3d Decade of the Memoirs of the Geological Survey, I requested Professor Sedgwick to permit me to examine the type specimens belonging to the Geological Collection of the University of Cambridge, a favour which the learned professor most kindly and readily granted. These urchins had been labelled by Professor M'Coy *Hemicidaris stramonium*, Agassiz, and were catalogued as such in the Addenda to his Paper on some new Mesozoic Radiata, published in the 'Annals of Natural History.' On examination, these urchins proved to be two small imperfect specimens of *Hemicidaris intermedia*, from the Coral Rag, Calne. On placing these specimens side by side with a true *Hemicidaris stramonium*, Agass., kindly sent me by M. Michelin, the difference between

them is seen to be very great. The size and prominence of the inter-ambulacral tubercles in *Hemicidaris stramonium*, the magnitude and spaced-out arrangement of the semi-tubercles at the base of the ambulacra, and the rudimentary condition of the marginal granules on the upper half of these areas, form a group of characters by which this species is readily distinguished from its congeners. It belongs, moreover, to beds newer than the Kimmeridge Clay.

This species must, therefore, be omitted from our list of British *Hemicidaris*.

right plate; the postero-lateral and single plates are nearly alike in size, but the single one is the smallest; all the genital holes are marginal; as the anal opening is transversely oval, and enlarged at their expense, that aperture is excentral. The ocular plates are small, heart-shaped bodies, wedged in between the truncated apices of the ambulacra and the genital plates; the eyeholes are quite marginal.

The spines (fig. 4 *c*, *d*) are sub-cylindrical, and slightly compressed on the sides; the diameter of the largest spine is about one tenth of an inch; they are all so much weathered, that the longitudinal lines on their surface cannot be seen; above the prominent milled ring (fig. 4 *c*) there is a broad, well-defined space, marked with longitudinal lines, which forms an important diagnostic mark between this species and its congeners. The articulating head is small, and the acetabulum diminutive.

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HEMICIDARIS STRAMONIUM, Agassiz.

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| HEMICIDARIS STRAMONIUM. | M'Coy, New Mesozoic Radiata, Annals and Magazine of Natural History, vol. ii, new series, p. 420. |
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them is seen to be very great. The size and prominence of the inter-ambulacral tubercles in *Hemicidaris stramonium*, the magnitude and spaced-out arrangement of the semi-tubercles at the base of the ambulacra, and the rudimentary condition of the marginal granules on the upper half of these areas, form a group of characters by which this species is readily distinguished from its congeners. It belongs, moreover, to beds newer than the Kimmeridge Clay.

This species must, therefore, be omitted from our list of British *Hemicidaris*.

NOTES

ON FOREIGN JURASSIC SPECIES OF THE GENUS HEMICIDARIS NEARLY ALLIED TO
BRITISH FORMS, BUT WHICH HAVE NOT YET BEEN FOUND IN THE ENGLISH OOLITES.

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- HEMICIDARIS CRENULARIS. Lamarck's (sp.), Goldf., Petrefact., p. 122, t. 40, fig. 6.
 — — Agassiz, Echinod. Foss. Suisse, II, p. 44, t. 18, figs. 23, 24 ;
 t. 19, figs. 10—12.
 — — Cotteau, Études Échinides Foss., p. 122, t. 13, figs. 1—9.

Test globular, flattened at the base, and on the upper surface. Ambulacral areas narrow, and flexuous above ; six pairs of close-set semi-tubercles at the base, and two rows of minute tubercles on the sides, running into one row in the upper part of the areas ; inter-ambulacra with seven or eight large tubercles in each of the two rows. Mouth opening very large, one half the diameter of the test ; peristome deeply incised into ten nearly equal sized lobes. Apical disc small.

Spines large, thick, claviform, gradually increasing in thickness from the head to the distal extremity ; surface covered with longitudinal lines. The largest spines are once and two thirds the length of the diameter of the test ; milled ring small, stem without any apparent neck.

The greater size of the mouth opening, the depth of the notches in the peristome, the greater equality in the size of the lobes, with less tumidity at the base of the test, added to the claviform character of the spines, serve to distinguish this species from *Hemicidaris intermedia*, which in other respects it most closely resembles.

Dimensions.—Height, one inch and one fifth ; breadth, one inch and a half.

Formation.—Corallien of Switzerland, and of France.
Coral Rag, Nattheim.

Collections.—In all Foreign Collections of Jurassic Fossils.
British Museum, my Cabinet.

HEMICIDARIS DIADEMATA. Agassiz, Echinoderm. Foss. Suisse, II, p. 49, t. 19, figs. 15—17.

Cotteau, Études Échinides Foss., p. 128, t. 14, figs. 1—5.

Test hemispherical, sub-inflated below, and depressed at the upper surface. Ambulacral areas straight, wide and expanded below to enclose six pairs of large semi-tubercles; narrow above, with four rows of small granules; more or less irregularly disposed. Inter-ambulacral areas with two rows of tubercles, which are large and prominent at the equator, but are very small, and become suddenly dwarfed, on the upper surface. Apical disc large. Mouth opening large; peristome deeply notched, divided into ten nearly equal-sized lobes.

Dimensions.—Height, seventeen twentieths of an inch; breadth, one inch and four tenths.

Formations.—"Portlandien inférieur? Astartien de la Vallée de la Birse, de Porrentruy, du Jura Soleurois, rare."—*Desor*.

"Hobel, Soleure."—*Michelin*. "Corallien étage Drûges, Yonne."—*Cott*.

Collections.—Museum Neuchâtel. Coll. Michelin, Cotteau, Wright.

HEMICIDARIS STRAMONIUM. Agassiz, Echinoderm. Foss. Suisse, II, p. 47, t. 19, figs. 13, 14.

Test small, thick, sub-spheroidal. Ambulacral areas narrow and flexuous, with six or seven large, prominent semi-tubercles, extending in a zigzag line to near the circumference: upper part of the area with two marginal rows of small granules. Inter-ambulacral areas with six tubercles in each row; the bosses are large and prominent and the tubercles are large, especially on the upper part of the test. "Spines cylindrical, with a prominent milled ring, without a distinct neck; surface covered with small sporadic granules."—*Desor*.

Dimensions.—Height, three fifths of an inch; breadth, nine tenths of an inch.

Formations.—Portlandien inférieur (Astartien) de Delémont, Rædersdorf, Pfeffingen, de Chablis (Yonne).

Collections.—Museums Neuchâtel, Zurich, Bale. Coll. MM. Michelin, Cotteau.

The specimen in my Cabinet, sent by M. Michelin, is from Le Loile près la chaux de fonds Neuchâtel.

HEMICIDARIS ALPINA. Agassiz, Echinoderm. Foss. Suisse, II, p. 52, t. 18, figs. 19—22.

Test large, sub-conoidal. Ambulacra wide, with six pairs of large, close-set semi-tubercles at the base; two marginal rows of round granules above, and between these four or five rows of a microscopic miliary granulation. Inter-ambulacra with eight tubercles in each column. Mouth opening large, peristome deeply notched, lobes nearly equal. Apical disc of moderate size, elements nearly equal.

Dimensions.—Height, nine tenths of an inch; breadth, one inch and one quarter.

Formation.—"Portlandien moyen (Kimméridgian) de Gesné et des Ormonds (Alpes Vaudoises), très rare."—*Desor*.

Collections.—Museums of Berne and Zurich

HEMICIDARIS THURMANNI. Agassiz, Echinoderm. Foss. Suisse, II, p. 50, t. 19, figs. 1—3.

Test small, depressed. Ambulacral areas narrow and very flexuous, with small semi-tubercles at the base, and minute marginal tubercles above. Inter-ambulacral areas wide, with three or four tubercles only in each row, which have very prominent bosses; the areolas are each surrounded by a complete circle of scrobicular granules. Mouth opening large, peristome divided by notches into ten nearly equal-sized lobes.

Dimensions.—Height, eleven twentieths of an inch; breadth, one inch and one tenth.

Formations.—"Portlandien moyen (Marnes Ptérocériennes) du Banné près Porrentruy, de Delémont, du Jura Vaudois, des environs de Salins."—*Desor*.

Collections.—Museums of Neuchâtel and Bale. Coll. Michelin, Thurmann; common.

HEMICIDARIS HOFMANNI. Syn. *Cidarites Hofmanni*. Roemer, Oolitic Gebirges, p. 25, t. 1, fig. 18.

Test small, sub-spheroidal, flat at the summit. Ambulacral areas narrow, convex, and slightly flexuous, with five or six pairs of semi-tubercles at the base, and two rows of small

marginal granules above. Inter-ambulacral areas with seven tubercles in each row; areolas confluent. Apical disc prominent, the anterior pair of genital plates the largest. Mouth opening of moderate width, peristome nearly equal lobed.

Dimensions.—Height, two fifths of an inch; breadth, nineteen twentieths of an inch.

Formations.—"Portlandien moyen, Kimméridgien, du Spielberg (Hanover), de Fritzow en Poméranie."—*Desor*.

Collections.—Museum Neuchâtel. Coll. Roemer, my Cabinet. Sent me by Professor Roemer.

HEMICIDARIS MITRA. Agassiz, Echinoderm. Foss. Suisse, II, p. 48, t. 17, figs. 7—9.

Test hemispherical, inflated towards the base. Ambulacra prominent and nearly straight, semi-tubercles small. Inter-ambulacral tubercles more crowded together than in *Hemicidaris intermedia*; areolas all confluent. Peristome deeply notched, and nearly equal lobed.

Dimensions.—Height, seven tenths of an inch; breadth, one inch.

Formations.—"Portlandien moyen (Calcaire à Tortues) de Saint Nicolas près Soleure Ptérocérien de Pierre-Percée (Jura) assez rare."—*Desor*.

Collections.—Museum Neuchâtel. Coll. Thurmann.

Family 3—DIADEMADÆ.

This family includes large and small urchins, with the test thin, circular, pentagonal, or sub-pentagonal; more or less depressed; mouth opening large, central; peristome decagonal, and divided into ten lobes by deep notches.

Apical disc small, directly opposite to the mouth, and composed of five genital, and five ocular plates; the anterior pair of genital plates are, in general, a little larger than the posterior pair; and the right antero-lateral plate, with the small, spongy, madreporiform body on its surface, is the largest. The vent is round or oblong, and is generally in the centre of the genital circle.

The ambulacral areas are more or less wide; sometimes they are one half the width of the inter-ambulacral areas, and furnished with two or four rows of primary tubercles, often as large and as numerous as those of the inter-ambulacral areas.

The poriferous zones are narrow, and almost always straight; the pores are unigeminal, bigeminal, or trigeminal in their disposition in different genera.

The inter-ambulacral areas are, in general, twice the width of the ambulacral; there are from eight to fourteen plates and upwards in each column; the areas are occupied by two, four, six, or eight rows of primary tubercles, nearly all of the same size; or there are rows of primary tubercles, with two or four rows of secondary tubercles, much smaller in size, filling up the interspaces of the area. The bosses of the tubercles are small, and their summits are in general crenulated, but sometimes they are uncrenulated; the spinigerous tubercles are small; in general they are perforated, rarely are they imperforate; the presence or absence of these characters, added to the structure of the poriferous zones, afford, when taken collectively, good generic characters.

In general the inter-ambulacral tubercles are larger than the ambulacral, but sometimes they are of equal sizes in both areas, a character which distinguishes the genera of this family from those of the Cidaridæ and Hemicidaridæ.

The spines in the living genera are long, slender, and tubular; sometimes they are thrice the length of the diameter of the shell.* In the fossil genera they rarely attain the length of the diameter of the shell, and are stout and solid; the slender, tubular spines have their surface ornamented with oblique annulations of fringe-like scales; whilst the surface of the solid fossil spines is covered with fine, longitudinal lines; but neither prickles nor other asperities are developed on their stems.

Lamarck† subdivided Klein's genus *Cidaris* into two sections, the "*Turbans*" and the

* Peters, Über die Gruppe der Diademen, p. 7.

† 'Histoire des Animaux sans Vertèbres,' tom. iii, 1st edit., pp. 54—58.

“*Diadems* ;” these Dr. Gray* afterwards converted into two genera, separating from the Diadems *Cidaris radiata*, Leske,† as the type of his new genus *Astropyga*. The genus *Cidarites* of Lamarck was considered as a natural family, composed of the genera *Cidaris*, *Diadema*, and *Astropyga*, which he thus characterised :

Family 1. CIDARIDÆ. *Cidarites*, Lamarck.

Body with two-sized spines ; larger ones club-shaped, or very long ; spine-bearing tubercles perforated at the apex.

Genus 1. *Cidaris*, Klein, Lamarck ; *Turbans*.

Body depressed, spheroidal ; ambulacra waved ; small spines compressed, two edged, two rowed, covering the ambulacra, and surrounding the base of the larger spines.

This genus may be divided according to the form of the larger spines ; the extra-ambulacral beads have only two rows of spines.

Cidaris imperialis, Lamk., Klein, t. 7, fig. A.

Genus 2. *Diadema*. *Diadems*.

Body orbicular, rather depressed ; ambulacra straight, spines often fistulous.

Echinometra setosa, Rumph., Leske, Klein, t. 37, figs. 1, 2.

Echinus diadema, Linn., Syst. Nat., by Turton, vol. iv, p. 139.

Echinus calamaria, Pallas, Spicil. Zool., t. 2, figs. 4—8.

Genus 3. *Astropyga*.

Body orbicular, very depressed ; ambulacra straight ; ovarian scales very long, lanceolate ; beads with several series of spines.

Cidaris radiata, Leske, Klein, t. 44, fig. 1.

The very meager characteristics by which this author has defined the last two genera only show that a difference exists, but his description is insufficient for a correct diagnosis between them ; hence various opinions exist regarding the characters and limits of the genus *Diadema* ; and only one of the species enumerated as types, the *Diadema setosa*, Rumph., is admitted to be a true Diadem. The valuable memoir of Herr W. Peters‡ has removed some of the difficulties that surrounded this subject, and his grouping of the living Diadems makes an important step towards a natural classification of one section of

* ‘Annals of Philosophy,’ new series, vol. x, p. 426, 1825. “An attempt to divide the Echinidæ or Sea Eggs into Natural Families.”

† Leske apud Klein, ‘Naturalis Dispositio Echinodermatum,’ t. 44, fig. 1, p. 116.

‡ Über die Gruppe der Diademen, ‘Gelesen in der Königl. Akademie der Wissenschaften,’ Berlin, Aug. 1853.

this family. Although the present state of our scientific knowledge of the *Diademadæ* may be considered as transitional rather than positive, still we know enough to justify the separation of the fossil Diadems from the existing genera, as proposed by M. Desor.*

The Diademadæ, in fact, appear to consist of two types : one of these, with a few rare exceptions, appertains to the present epoch ; the other existed during the deposition of the secondary and tertiary rocks. The living forms are in general large, depressed urchins, with a thin shell, having the tubercles and pores variously arranged in the different genera. They have, in general, very long, slender, *tubular* spines, the surface of which is covered with oblique annulations of small imbricated scales. The fossil species, on the contrary, are smaller urchins, having a thicker test ; the tubercles and pores are variously disposed in the different genera ; the spines rarely attain the length of the diameter of the test ; they are *solid*, in general cylindrical, sometimes flattened or awl-shaped, and their surface is covered with fine longitudinal lines.

I propose to include the following genera in this natural family :

A Table showing the classification of the Diademadæ.

| | |
|-------------------|---|
| <i>Section A.</i> | |
| DIADEMADÆ. | Spines very long, slender, tubular, covered with oblique annulations of imbricated scales. Living in tropical seas. |
| | A few annulated tubular spines are found in the Upper Chalk and in the Coralline Crag. |
| | <i>Section B.</i> |
| | Spines short, slender, solid ; surface covered with fine longitudinal lines. |
| | Extinct in the Oolitic, Cretaceous, and Tertiary rocks. |
| | DIADEMA, <i>Gray</i> . SAVIGNYA, <i>Desor</i> . ASTROPYGA, <i>Gray</i> . ECHINOTHRIX, <i>Peters</i> . PSEUDODIADEMA, <i>Desor</i> . CYPHOSOMA, <i>Agassiz</i> . HEMIPEDINA, <i>Wright</i> . PEDINA, <i>Agassiz</i> . ECHINOPSIS, <i>Agassiz</i> . |

PSEUDODIADEMA,† *Desor*. 1854.

This genus is composed of small urchins, with a moderately thick test, which rarely attains two inches in diameter ; the ambulacral areas are in general one third, or even one half the width of the inter-ambulacra ; the primary tubercles of both areas are all perforated, and nearly of the same size ; their bosses are small, with sharply crenulated summits.

The ambulacral areas have two rows of tubercles ; the inter-ambulacral areas have two rows only, or two rows of primary, and two or four shorter rows of small secondary

* 'Synopsis des Échinides Fossiles.'

† The specific name given by Lamarck to the fossil urchin described as *Cidarites pseudodiadema*.

tubercles; or they have four, or even six rows of nearly equal-sized primary tubercles at the equator.

The poriferous zones are narrow and straight; the pores in one section are unigeminal throughout; but in another section they are bigeminal in the upper part of the zones.

The apical disc is seldom preserved; it is, in general, small; and the anterior pair of genital plates are larger than the posterior pair.

The mouth opening is large, the peristome is deeply notched, and the oral lobes are not very unequal sized.

The spines rarely attain the length of the diameter of the shell; they are in general much shorter, and are cylindrical or needle-shaped, and have a prominent, milled ring near the articulating head; the rim of the acetabulum is crenulated, and the socket perforated; the surface of the stem is sculptured with delicate longitudinal lines.

The *Pseudodiadema* are all extinct, and are found in the Liassic, Oolitic, Cretaceous, and Tertiary rocks.

Pseudodiadema differs from *Diadema* in having solid spines, with a smooth surface, the sculpture, in most cases, consisting of microscopic, longitudinal lines; whilst the spines of *Diadema* are tubular, and have oblique annulations of scaly fringes on their surface. It differs from *Cyphosoma*, which is a Cretaceous genus, in having the tubercles always perforated, those of *Cyphosoma* being imperforate.

It differs from *Hemipedina* in having a small apical disc, and tubercles with crenulated bosses, those of *Hemipedina* being smooth; and from *Pedina* in having the pores unigeminal or bigeminal, those of *Pedina* being arranged in triple, oblique pairs.

The *Pseudodiademas* may be divided into two sections, from the different manner the pores are arranged in the zones. In one group the pairs of pores are not so numerous, and they are disposed in a single file throughout; in another group the pores are more numerous, and crowded together in the upper part of the zones. Professor M'Coy* has proposed the genus *Diplopodia* for this group. *Cæterus paribus*, the crowding together of a greater number of pores in a zone is, at most, a sectional, and can never form a stable generic character, inasmuch as it is subject to great variation in the diplopodous species themselves, and is, moreover, often only an adult development.

* 'Annals and Magazine of Natural History,' 2d series, vol. ii, p. 412.

The following Table exhibits these Sections, and shows at the same time the arrangement of the tubercles in the unigeminal and bigeminal groups.

Section A.—*Pores unigeminal in the upper part of the zones :*

Examples.

- | | | |
|---|---|-------------------------------------|
| a. Two rows of primary tubercles only in the inter-ambulacral areas | } | <i>Pseudodiadema depressum.</i> |
| b. Two or four rows of primary tubercles, and two or four rows of smaller secondary tubercles in the inter-ambulacral areas | } | <i>Pseudodiadema hemisphæricum.</i> |

Section B.—*Pores bigeminal in the upper part of the zones :*

- | | | |
|--|---|---------------------------------|
| a. Two rows of primary tubercles, and two rows of small secondary tubercles, in the inter-ambulacral areas | } | <i>Pseudodiadema versipora.</i> |
| b. Four rows of primary tubercles in the inter-ambulacral areas | } | <i>Pseudodiadema variolare.</i> |

A. *Species from the Lias.*

PSEUDODIADEMA MOOREII, *Wright*. Pl. VI, fig. 1 a, b, c, d.

DIADEMA MOOREII. Wright, *Annals and Magazine of Natural History*, 1854, 2d series, vol. xiii, p. 171, pl. 12, fig. 3.

— — Morris, *British Fossils* 2d edit., 1854. Note on additional species of Echinodermata.

DIADEMOPSIS MOOREII. Desor, *Synopsis des Échinides Fossiles*, p. 81.

Test circular, depressed; ambulacral tubercles smaller than those of the inter-ambulacral areas; plates of the test covered with a small, wide-set, prominent granulation; mouth large and decagonal; anal opening large; apical disc of moderate size.

Dimensions.—Height, one fourth of an inch; transverse diameter, six tenths of an inch.

Description.—There is much difficulty in distinguishing some of the smaller Diademas from each other, inasmuch as the young condition of many of the larger species so closely resembles the adult state of others, that it is only after obtaining a number of individuals of different species in the various phases of their growth, that the naturalist feels himself

upon sure ground when endeavouring to distinguish the affinities and differences existing among them. After a diligent search for urchins in the Lias of Gloucestershire, I have succeeded in collecting from these rocks only a very few examples of this group. In addition to those found near Cheltenham, my friend Mr. Moore, of Bath, kindly presented me with a few specimens which he collected from the Upper Lias near Ilminster, and from these collective materials the species under consideration was discovered.

Pseudodiadema Moorei has a circular outline, slightly inclining to a pentagonal contour; it is much depressed at the upper surface, and is flattened at the base (fig. 1 *a*). The ambulacral areas are very narrow, being less than one third the width of the inter-ambulacral (fig. 1 *b*); their margins are occupied by two rows of tubercles, about eight in each row (fig. 1 *d*), which, at the base, and up to the equator, are nearly as large as those of the inter-ambulacra, but from that region to the apex of the area they rapidly diminish in size, and are here very disproportionate in magnitude to them; a zigzag line of single granulation separates the two rows of tubercles from each other (fig. 1 *d*). The inter-ambulacral areas are wide and well developed (fig. 1 *b*, *c*), from eight to nine in each row, which occupy the centre of the plates (fig. 1 *a*); the areolas of the tubercles on the upper surface are surrounded with a circle of granules which separates them from each other (fig. 1 *d*), but those of the base are confluent above and below (fig. 1 *c*). The miliary zone at the base of the test has a number of granules scattered over it (fig. 1 *e*); whilst on the upper surface the plates are destitute of any other ornament beyond the faint circles that surround the tubercles (fig. 1 *b*).

The poriferous zones are narrow, the pores are strictly unigeminal (fig. 1 *b*, *d*); the avenues are, however, rather flexuous below; the basal tubercles of both areas are nearly alike in size, but on the dorsal surface those of the ambulacra dwindle into large granules; whilst those of the inter-ambulacra maintain their size up to the last pair, which are small near the margin of the disc. The mouth opening is large (fig. 1 *e*), and the peristome is divided into ten nearly equal-sized lobes.

The apical disc is partly preserved in the specimen here figured (fig. 1 *b*). It consists of five large ovarian plates, of a heptagonal form; two of the sides unite with the inter-ambulacral plates, two with the ocular, two with the adjoining ovarials, and the single surface contributes to form the boundary of the anal opening, which is of moderate size; the five ocular plates are small and heart-shaped; their apex is directed towards the anal opening, and their base to the area; the madreporiform tubercle is slightly elevated on the right antero-lateral ovarian plate; the surface of all the discal elements is almost destitute of sculpture or granulation.

Affinities and differences.—*Pseudodiadema Moorei* resembles *Pseudodiadema depressum*, Agassiz, in the depression of its upper surface and the flatness of its base, likewise in having the tubercles of both areas nearly of a uniform size below; but it is readily distinguished from *Pseudodiadema depressum* by the number and greater develop-

ment of the tubercles of the ambulacra, which maintain their size throughout, whilst in *Pseudodiadema Moorei* the ambulacral tubercles are fewer in number, and more rudimentary in size, in all the upper part of the areas. The contour of the test, moreover, does not assume the pentagonal outline of *Pseudodiadema depressum*, nor has the upper surface of the inter-ambulacral areas the median depression seen on the test of the latter. The mouth opening is larger, and the decagonal lobes are more equal in size in *Pseudodiadema Moorei* than in *Pseudodiadema depressum*.

Locality and Stratigraphical position.—I have collected *Pseudodiadema Moorei* in the Upper Lias of Gloucestershire. Mr. Moore found it in the same stratum near Ilminster, with *Ammonites communis*, Sow., and *Ammonites serpentinus*, Schloth. Prof. Deslongchamps has communicated a specimen of this urchin, which he found in the Lias supérieur de May, Calvados, associated with *Leptæna Davidsonii*, Deslong., *Thecidium Bouchardii*, Davidson, and several other species of Upper Lias Mollusca.

I dedicate this species to Mr. Charles Moore, of Bath, whose assiduous practical researches in palæontology have brought to light so many interesting forms from the Middle and Upper Lias beds of Somersetshire.

B. *Species from the Inferior Oolite.*

PSEUDODIADEMA DEPRESSUM, *Agassiz*. Pl. VI, fig. 2 *a, b, c, d, e, f, g, h*.

DIADEMA DEPRESSUM.

— —
— —
— —
— —

Agassiz and Desor, Catalogue raisonné des Échinides, Annales des Sciences Naturelles, tom. vi, p. 349, 3^{me} série.
Cotteau, Études sur Échinides Fossiles, pl. 2, p. 43.
D'Orbigny, Prodrome de Paléontologie, tome i, p. 290, No. 512.
Morris, British Fossils, 2d edit., 1854, p. 76.
Wright, Annals and Magazine of Natural History, 2d ser., vol. viii, p. 258, pl. 12, fig. 2 *a, b, c, d*.

PSEUDODIADEMA DEPRESSUM. Desor, Synopsis des Échinides Fossiles, p. 65.

Test pentagonal, depressed; ambulacral areas convex and prominent; inter-ambulacral areas flattened; two rows of nearly equal-sized primary tubercles in both areas; no secondary tubercles; mouth large and decagonal; peristome nearly equally lobed.

Dimensions.—Height, eleven twentieths of an inch; breadth, one inch and three tenths.

Description.—The ambulacral areas of this urchin are rather more than one half the breadth of the inter-ambulacral areas, and have from ten to twelve pairs of well-developed primary tubercles, separated by a zigzag line of small granulations (fig. 2 *d*). The inter-

ambulacral areas are nearly of a uniform breadth throughout; there are about ten pairs of tubercles in each area. In consequence of these segments of the test being double the width of the ambulacra, the tubercles stand more apart (fig. 2 *d*). The tubercles of both areas are nearly uniform in size; those of the ambulacra are the smallest; they have a smooth base, with a finely crenulated summit, and are perforated (fig. 2 *h*); there are no secondary tubercles, but the miliary zones are covered with small granulations, which are closely set together on the surface of the plates; three or four of these at the base are perforated (fig. 2 *g*). The mammillary eminences of both areas are surrounded by smooth areolas, which are nearly all confluent (fig. 2 *d*). The ambulacral areas become rapidly contracted towards the vertex (fig. 2 *a*), whilst the inter-ambulacral maintain their breadth, so that the space between the rows of primary tubercles is very uniform in width throughout (fig. 2 *a, e*). The miliary zones, with the exception of the internal border of the four superior inter-ambulacral plates, are covered with small, close-set granulations of different sizes (fig. 2 *d*), which form semicircles around the areolas, and zigzag lines down the centre of the areas. The pores consist of from thirty-six to forty pairs in each avenue, super-imposed in a single file; about four pairs of pores are opposite each large inter-ambulacral plate (fig. 2 *d*); in the wide space of the avenues around the mouth, they form rows of triple oblique pairs (fig. 2 *g*). The mouth is large and decagonal (fig. 2 *b*); the notches of the peristome divide the opening into ten nearly equal-sized lobes, the borders of the notches are reflexed at the angles; the apical disc is unknown; the spines are small, subulate, and delicately striated longitudinally (fig. 2 *e, f, i*).

Affinities and differences.—This urchin resembles *Pseudodiadema æquale*, Agassiz, but differs from it in the absence of secondary tubercles in the inter-ambulacral areas; by its pentagonal form it resembles *Pseudodiadema versipora* Phillips, but is distinguished from that species in having the pores arranged in a single file; whereas in *Pseudodiadema versipora*, from the equator to the apical disc, the pores fall into double rows. The tubercles are likewise smaller, and more deeply perforated; it belongs, moreover, to a lower zone of the Oolitic group, *Pseudodiadema versipora* being a characteristic urchin of the Coral Rag of England and the “Terrains à Chailles” of Switzerland.* Like *Pseudodiadema versipora*, *Pseudodiadema depressum* possesses a pentagonal form, a peculiarity depending on the prominence of the ambulacral areas, and common to several species of this genus.

Locality and Stratigraphical position.—This urchin is common in the lower ferruginous beds of the Inferior Oolite, the Pea Grit, at Crickley, Leckhampton, and Dundry Hills. I have collected it from the Great Oolite at Minchinhampton, and from the Bradford Clay at Tetbury-road Station. The Inferior Oolite specimens are in general much crushed;

* Agassiz, ‘Echinodermes Fossiles de la Suisse.’

the apical disc is always broken, but the spines are sometimes adherent to the test (fig. 2 i). It has been collected by M. d'Orbigny in the Inferior Oolite of Saint Honorine, Ranville, where it is abundant. I have before me a specimen collected from the "Oolite Ferrugineuse de Bayeux" so closely resembling some of those from Crickley Hill, that it might readily be taken for an urchin from that locality. My friend M. Deslongchamps, who has kindly lent me this specimen for comparison, observes, "seul exemplaire que j'ai trouvé;" so that it must be rare in Normandy. It has been obtained by M. Cotteau from the Ferruginous Oolite, of "Tour-du-Prè, près Avallon, département de l'Yonne," which bed lies upon the Calcaire à Entroques, the true equivalent of the Dundry, Cotteswold, and Dorsetshire beds of the Inferior Oolite.

History.—*Pseudodiadema depressum* was first mentioned in the 'Catalogue raisonné des Échinides' by Agassiz and Desor, but was neither figured nor described by them. This, however, has been done by M. Cotteau, in his 'Études sur les Échinides Fossiles.' In both countries it appears to characterise beds belonging to the same geological horizon.

C. Species from the Stonesfield Slate.

PSEUDODIADEMA PARKINSONI, Desor. Pl. VI, fig. 4.

PSEUDODIADEMA PARKINSONI. Desor, Synopsis des Échinides Fossiles, p. 66.
Parkinson's Organic Remains, vol. iii, pl. 1, fig. 8, not named
in this work.

Test small, circular, depressed; ambulacral areas wide; tubercles of the inter-ambulacral areas a little larger than those of the ambulacral; no secondary tubercles; spines thick, subulate, and a little bent, nearly as long as the diameter of the test, surface covered with longitudinal lines.

Dimensions.—Transverse diameter, three fifths of an inch; height unknown.

Description.—This pretty little Diadem has been overlooked by all English authors except Parkinson, who figured it in his 'Organic Remains,' and only observes (vol. iii, p. 10), "This very uncommonly perfect specimen from Stunsfield, Oxfordshire (Pl. I, fig. 8), in which a considerable number of spines are still adherent to the shell, appears to be of the same species with the last fossil" (a Wiltshire *Pseudodiadema*). M. Desor, in his 'Synopsis,' names this species *Parkinsoni*, and adds the following note: "Je ne connais cette espèce que par la jolie figure qu'en a donnée Parkinson. Il est surprenant qu'aucun des auteurs Anglais ne l'ait encore mentionnée, ni ne lui donné un nom. Parkinson s'est borné à la figurer sans lui imposer un nom."

When collecting materials for my 'Memoir on the Cidaridæ,' this species engaged my attention, and I endeavoured, in vain, to find the original of Parkinson's figure, as I was under the impression that it was a juvenile form of *Pseudodiadema versipora*, from the Coral Rag of Wiltshire, very much resembling a specimen in the cabinet of Mr. Mackniel, of Trowbridge; for this reason it was not included in my 'Memoir.' As M. Desor has now, however, named the specimen, and entered it in his 'Synopsis,' I have considered it desirable to have an accurate copy of Parkinson's figure transferred to my work.

The ambulacral areas are moderately wide, and carry two rows of tubercles nearly as large as those of the inter-ambulacral areas; the pores are arranged in a single file throughout; the inter-ambulacral areas are about once and a half as wide as the ambulacral, and have two rows of primary tubercles; nor is there any evidence of the existence of a secondary range; the spines are thick and subulate, slightly bent in the middle, and marked with longitudinal lines; they are nearly as long as the diameter of the shell and are very robust in proportion to its dimensions.

Affinities and differences.—This species resembles *Pseudodiadema depressum* in the absence of secondary tubercles; but that species is distinguished from it by the test being more circular, and its spines being thicker and bent. It may, however, be a juvenile form of *Pseudodiadema versipora*, from the Coral Rag, the artist having overlooked the crowding together and doubling of the pairs of pores in the upper part of the poriferous zones; not having the advantage of examining the specimen, I make these remarks with much hesitation, well knowing from experience how readily we may be deceived by figures, where no details are added, to indicate the specialities of the organism.

Locality and Stratigraphical position.—Mr. Parkinson says it was collected from the Stonesfield Slate at Stonesfield, Oxon, where it must be exceedingly rare. I have collected fragments of a small *Pseudodiadema* from the Yellow Clays of the Stonesfield Slate at Sevenhampton, Gloucestershire, which may belong to this species. My specimens are mislaid, but they were not in a good state of conservation.

D. *Species from the Great Oolite.*

PSEUDODIADEMA PENTAGONUM, *M'Coy*. Pl. VI, fig. 3 *a, b, c, d.*

DIPLOPODIA PENTAGONA. *M'Coy*, Annals and Magazine of Natural History, 2d series, vol. ii, p. 412.

DIADEMA PENTAGONUM. *Morris*, Catalogue of British Fossils, 2d edition, 1854, p. 77.

— — *Woodward*, Memoirs of the Geological Survey, Decade V. Notes on Brit. Foss. Diademas.

Test small, pentagonal, depressed; ambulacral areas with two marginal rows of primary

tubercles nearly as large as those of the inter-ambulacra; poriferous zones wide; pores unigeminal at the equator, bigeminal on the upper and under parts of the zones; inter-ambulacral areas thrice the width of the ambulacral, with two rows of primary tubercles, and a short row of secondary tubercles, one third the size of the primaries, between the peristome and equator, situated between the zones and the primary row.

Dimensions.—Height, three tenths of an inch; transverse diameter, seventeen twentieths of an inch.

Description.—This pretty little urchin is said by Professor M'Coy, who first described it, to be not uncommon in the Great Oolite of Minchinhampton, but experience has taught me that it is a very rare form in the rich shelly beds of that remarkable locality.

The test is moderately thick, and much depressed (Pl. VI, fig. 3 *a, b*); it is distinctly pentagonal, from the prominence of the ambulacra, and in its general *facies* very much resembles *Pseudodiadema depressum*; but the structure of the poriferous zones, and the crowding together of the pores in the zones, shows it to be very distinct from that Inferior Oolite form. It belongs, in fact, to that section of the genus *Pseudodiadema* which has the pores bigeminal in the upper part of the zones (Pl. VI, fig. 3 *c*), a structure which Professor M'Coy thought of generic value, and proposed the genus *Diplopodia** for the reception of these bigeminal Diadems, describing the species now under consideration as a type of the same.

The ambulacral areas are narrow and prominent, with two rows of from twelve to fourteen primary tubercles, nearly as large as those of the inter-ambulacral areas (fig. 3 *d*); a few miliary granules separate the tubercles in the middle of the areas, but they disappear in their upper and lower parts, in consequence of the close approximation of the tubercles in these portions of the area (fig. 3 *b, c*).

The poriferous zones are wide, especially above and below; near the equator there are five or six pairs of pores, which are unigeminal (fig. 3 *b*); but above these the pairs of pores are bigeminal, each pair being separated by a diagonal line, formed by an elevation of the surface of the zonal plates (fig. 3 *c*); between the unigeminal portion of the zones and the peristome the pores are rather irregularly bigeminal, they then fall into triple, oblique pairs near the mouth; the upper part of the zones consists of small pyriform plates (Pl. VI, fig. 3 *c, d*), which are neatly dovetailed together, the line of union being marked by diagonal lines of elevation (fig. 3 *d*).

The inter-ambulacral areas are three times the width of the ambulacral; they have two rows of primary tubercles, from ten to twelve in each row, situated on the centre of the plates; they are about the same size as the ambulacral tubercles at the equator, but are much larger in proportion in the upper part of the area (fig. 3 *d*); the bosses are small,

* 'Annals and Magazine of Natural History,' 2d series, vol. ii, p. 412.

having their summits feebly crenulated, and the tubercles not deeply perforated. The areolas are superficial, and confluent above and below (fig. 3 *d*); five or six granules form semicircles on each side of the areola. The miliary zone, which is of moderate width, contains few granules besides those forming the scrobicular semicircles, in the upper part of the test this space is almost naked; between the peristome and the equator there are five or six secondary tubercles, about one third the size of the primaries, situated between them and the poriferous zones, forming a short, irregular row, which scarcely reaches the middle of the test (fig. 3 *b*).

The mouth opening in width is nearly one half the diameter of the test; the peristome is unequally decagonal, the ambulacral being larger than the inter-ambulacral lobes.

The disc opening is large, and nearly circular; but the disc is absent in all the specimens I have examined, and in none of them are the spines preserved.

Affinities and differences.—*Pseudodiadema pentagonum* very much resembles *Pseudodiadema depressum* in its pentagonal and depressed form, in having the primary tubercles of both areas at the equator nearly of equal size, and in having the upper part of the miliary zones almost naked; but it is distinguished from that species in having a short row of secondary tubercles at the base, between the inter-ambulacral primary tubercles and the poriferous zones; in having the poriferous zones wide, and the pores bigeminal in all the upper portion of the zones, a character which is at once evident and distinctive between these two nearly allied forms. *Pseudodiadema pentagonum* resembles *Pseudodiadema versipora* in its depressed and pentagonal form, and in the bigeminal character of the pores in the upper parts of the zones; but it is distinguished from that beautiful Coral Rag urchin in having much smaller primary tubercles, and fewer and larger granules in the miliary zones; the central and lateral zones of the inter-ambulacra in *Pseudodiadema versipora* being much wider, and filled with several rows of small, close-set granules; whereas in *Pseudodiadema pentagonum* there are few granules besides those forming the scrobicular semicircles. The diplopodous character of this species serves to distinguish it from all other British Oolitic Diadems.

Locality and Stratigraphical position.—This beautiful urchin has been found in the shelly beds of the Great Oolite at Minchinhampton, where it is very rare. Associated with it are the following Echinoderms: *Acrosalenia hemiciaroides*, Wright; *Polycyphus nodulosus*, Münster; *Pygaster semisulcatus*, Phillips; *Hyboclypus agariciformis*, Forbes; *Echinobrissus clunicularis*, Llhwyd.

History.—First described by Professor M'Coy in the 'Annals of Natural History,'* in his paper "On some new Mesozoic Radiata," under the name *Diplopodia pentagona*, and regarded by him as the type of a new genus of DIADEMADÆ, which he supposed was

* 'Annals and Magazine of Natural History,' 2d series, vol. ii, p. 412.

limited to the Oolites; but it has been ascertained that the same diplopodous structure of the poriferous zones is found to prevail likewise in several Cretaceous species, as well as in those cited by this author. Neither Prof. Agassiz nor the late Prof. Edward Forbes considered the diplopodous character of the poriferous zones alone of generic importance; but Professor M'Coy and M. Desor think otherwise, the latter author having retained the genus *Diplopodia* in his 'Synopsis des Échinides Fossiles.' I am indebted to Professor Sedgwick for the loan of the type specimen belonging to the Cambridge Museum, which is now figured (Pl. VI, fig. 3 *a, b*) for the first time.

PSEUDODIADEMA HOMOSTIGMA, *Agassiz*. Pl. VI, fig. 5 *a, b, c, d, e, f*.

DIADEMA HOMOSTIGMA.

Echinodermes Fossiles de la Suisse, part ii, t. 17, figs. 1—5, p. 24.

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Agassiz and Desor, Catalogue raisonné Échinides, Annales des Sciences Naturelles, 3^e série, tome vi, p. 347.

— *ÆQUALE*.

Quenstedt, Petrefactenkunde, t. 49, fig. 29, p. 579?

PSEUDODIADEMA HOMOSTIGMA.

Desor, Synopsis des Echinides Fossiles, p. 65.

DIADEMA HOMOSTIGMA.

Woodward, Memoirs of the Geological Survey, Decade V, Notes on British Fossil Diademas.

Test small, depressed, nearly circular; ambulacral areas nearly as wide as the inter-ambulacral; primary tubercles in both, nearly of the same size; no secondary tubercles; poriferous zones unigeminal; mouth opening large, peristome unequally decagonal.

Dimensions.—Height, one fifth of an inch; transverse diameter, half an inch.

Description.—This beautiful little species was first discovered by M. Nicolet in the Inferior Oolite of Chaux-de-Fonds, and figured and described by M. Agassiz in his 'Echinodermes Fossiles de la Suisse,' who, in describing it, observes, "the species which I have figured under this name offers none of those prominent traits which we recognise in so many species. It also presents a uniformity almost hopeless for description. Up to the present (1840) I only know the specimen I have figured, which is all the more valuable on account of the rock (Inferior Oolite) from whence it was collected, for we know in what a bad state of preservation the most of the fossils of this terrain are found in." It is probable that the small *Diadema æquale*, figured by Quenstedt from the Brown Jura δ of Spaichingen, is identical with *Pseudodiadema homostigma*, as it has been collected from the same geological horizon, and wants the rows of secondary tubercles, which characterise that Coral Rag form.

The ambulacral areas are nearly as wide as the inter-ambulacral areas, and support

two rows of primary tubercles, eight to nine tubercles in each row; those at the equator are nearly as large as the tubercles in the inter-ambulacra in the same region of the test (fig. 5 *d*); the summits of the bosses are sharply crenulated, and the tubercles are small and perforated; a zigzag row of small granules extends down the middle of the area (fig. 5 *e*), and small transverse branches shoot out from the sides, and extend to the poriferous zones, separating the bosses from each other, and forming imperfect areolar circles around them.

The poriferous zones are narrow, and the pores are unigeminal throughout (fig. 5 *e*); the zones approach each other very closely in the upper part of the test (fig. 5 *b*), which gives to the inter-ambulacra the uniform width they have (fig. 5 *b*, *d*).

The inter-ambulacral areas are a very little wider at the equator than the ambulacral (fig. 5 *c*); from the equator upwards they maintain a very uniform width (fig. 5 *b*); there are nine tubercles in each of the two rows, which are set on small bosses, with sharply crenulated summits; the tubercles are prominent and perforated (fig. 5 *f*); the areolas are confluent above and below (fig. 5 *b*); between the tubercles and the poriferous zones a row of unequal-sized granules extends (fig. 5 *e*), which forms one side of the scrobicular circle; the miliary zone is narrow, consisting, from the peristome to the equator, of two rows of granules, from the equator upwards a few more granules are interspersed with them, these form the other portion of the scrobicular circle (fig. 5 *e*); the upper part of the zone is naked in the region of the central suture (fig. 5 *b*).

The mouth opening is large, the peristome is unequally decagonal (fig. 5 *c*), the ambulacral lobes being the largest. The base of the test (fig. 5 *c*) shows how uniform the structure of this *Pseudodiadema* is; and the uniformity in the size of the tubercles in this region gives value to its specific name, *homostigma*.

The discal opening is small, and nearly circular; but the plates of the disc are absent.

Affinities and differences.—This species is distinguished from the smaller forms of *Pseudodiadema depressum* in being nearly circular, in having wider ambulacra, a smaller discal opening, and more equal-sized tubercles. It has many affinities with *Pseudodiadema Bailyi* (Pl. VI, fig. 1); but is distinguished from it in having proportionately wider ambulacra, the primary tubercles likewise are of a more uniform size throughout the area, those of *Pseudodiadema Bailyi* diminishing more rapidly in the upper part of this region.

Locality and Stratigraphical position.—I have collected this species in the Bradford Clay, near the Tetbury-road Station of the Great Western Railway, and Mr. William Buy has collected it in the Cornbrash near Sutton-Benger, Wilts. It is rather a rare form in these beds. My excellent friend, the Rev. W. Griesbach, has kindly sent me a specimen which he found in the marly beds of the Great Oolite at Wollaston, Northamptonshire, associated with several Great Oolite and Cornbrash species of Echinodermata.

E. Species from the Cornbrash.

PSEUDODIADEMA BAILYI, *Wright*, nov. sp. Pl. VII, fig. 1 *a, b, c, d, e, f, g.*

Test sub-pentagonal, depressed; ambulacral areas narrow, a little more than half the width of the inter-ambulacral, with two rows of primary tubercles, smaller than those of the inter-ambulacra; inter-ambulacral areas with two rows of primary tubercles, which suddenly diminish in size above the equator; poriferous zones narrow, and unigeminal throughout; mouth opening large, peristome nearly equally decagonal.

Dimensions.—Height, three tenths of an inch; transverse diameter, seven tenths of an inch.

Description.—This beautiful little Diadem, like the preceding species, presents such a uniformity of structure, and such a total absence of prominent characters, that it is extremely difficult to form an accurate diagnosis of its specific form.

The test is small, depressed, and sub-pentagonal (fig. 1 *a, b*); the ambulacral areas are prominent, and rather more than half the width of the inter-ambulacral; they support two rows of primary tubercles, rather smaller than the inter-ambulacral tubercles, of which there are eight in each row; a central, zigzag line of granules separates the two rows of tubercles from each other (fig. 1 *f*), and short, transverse, granular branches separate the areolas of the larger equatorial tubercles; on the upper part of the areas the tubercles become very small; the poriferous zones are straight and narrow (fig. 1 *e*), and the pores are strictly unigeminal throughout (fig. 1 *f*); there are five pairs of pores opposite one of the larger inter-ambulacral plates, and from three to four pairs opposite the ambulacral plates (fig. 1 *f*).

The inter-ambulacral areas are nearly twice the width of the ambulacral; they are occupied by two rows of primary tubercles, there being eight tubercles in each row; from the peristome to the equator the tubercles gradually increase in size (fig. 1 *d*), but above the equator they diminish rather suddenly in magnitude (fig. 1 *e*), so that the tubercles on the upper parts of the areas are small in proportion to those at the equator and base of the test (fig. 1 *d*); the areolas are wide; the bosses are large, conical, and prominent (fig. 1 *d, f, g*); they are confluent above and below, but laterally they are bounded by semicircles of granules (fig. 1 *g*), five or six granules, with a few other microscopic ones, forming incomplete scrobicular semicircles around their sides; the miliary zone is narrow, and formed only by the granules just described; on the upper part of the area the granules almost entirely disappear, and the surface of the plates is naked near the point where they approach the disc (fig. 1 *e*); the summit of the conical bosses is crenulated (fig. 1 *g*), and the tubercle is small and perforated (fig. 1 *f*). There are no secondary tubercles at the base of this species.

The base is flat (fig. 1 *b*); the mouth opening is large (fig. 1 *b d*); the peristome is deeply notched, and the surface of the test sharply everted (fig. 1 *d*); the ambulacral are rather larger than the inter-ambulacral lobes; the margins of the latter have two pointed processes at the angles of the notches.

The disc opening is large (fig. 1 *a, c*); but as the margin is fractured, its true diameter cannot be accurately ascertained.

Affinities and differences.—This species has so many affinities with *Pseudodiadema homostigma*, that at one time I regarded it only as a large pentagonal variety of that species; the narrowness of the ambulacra, however (these areas being a little more than half the width of the inter-ambulacra, whilst those of *Pseudodiadema homostigma* are nearly as wide as the inter-ambulacra), added to the sudden diminution in the size of the tubercles in the upper part of the areas, and the greater prominence of all the bosses, induced me to separate it from *Pseudodiadema homostigma*.

Locality and Stratigraphical position.—This species was collected by Mr. William Buy, from the Cornbrash near Sutton, Wilts, associated with *Acrosalenia hemiciaroides*, Wright; *Acrosalenia spinosa*, Agassiz; and *Echinobrissus clunicularis*, Llhwyd. I have dedicated this species to Mr. W. H. Baily, whose crayon has so accurately delineated many of the forms figured in this Monograph.

PSEUDODIADEMA BAKERIÆ, Woodward. Pl. VII, fig. 2 *a, b, c*.

DIADEMA BAKERIÆ. Woodward, Memoirs of the Geological Survey, Decade V. Notes on British Fossil Diademas.

Test sub-pentagonal, depressed; ambulacral areas narrow, with two rows of primary tubercles, about thirteen in each row; poriferous zones narrow, pores unigeminal, near the mouth trigeminal; inter-ambulacral areas wide, with two rows of primary tubercles, larger than the ambulacral, about thirteen in each row; bosses not prominent, summits slightly crenulated; tubercles small, flat, and finely perforated; miliary zone wide, and sparingly granulated.

Dimensions.—Height, eleven tenths of an inch; transverse diameter, one inch and four tenths of an inch.

Description.—The specimen, unfortunately, is not in good preservation, having been much weathered and bouldered (fig. 2 *a, b*). The ambulacral areas are narrow and

straight, with two rows of small primary tubercles (fig. 2 c), about thirteen in each row; their bosses are small, and set closely together; a zig-zag central line of granules descends between the rows, and a few scattered granules separate the areolas above and below from each other.

The poriferous zones are straight and narrow, the pores are unigeminal and contiguous, and the pairs of pores are obliquely inclined (fig. 2 c); three pairs of holes are opposite one ambulacral plate, and five pairs are opposite one inter-ambulacral plate (fig. 2 c); near the peristome the pores fall into triple oblique pairs.

The inter-ambulacral areas are rather more than twice and a half as wide as the ambulacral; they have two rows of primary tubercles, with thirteen in each row; they are considerably larger than those of the ambulacral areas; their bosses have a broad base, but their summits are not deeply crenulated (fig. 2 c); the spinigerous tubercles are small, flat, and minutely perforated; the central miliary zone is wide, but sparingly granulated in the middle, and almost naked above; on each plate (fig. 2 c) two rows of granules form a lateral zone, separating the tubercles from the poriferous avenues, and two rows of granules form one half of the central zone; in the upper part of the area the areolas are separated by transverse rows of granules, which, with the lateral rows, form three fourths of a scrobicular circle. The weathered condition of the specimen renders a more minute description of the test impossible.

The mouth opening measures eleven twentieths of an inch, that of the diameter of the test being one inch and four tenths; the peristome is deeply notched, and unequally lobed, the inter-ambulacral being one third less than the ambulacral lobes.

The disc opening is four tenths of an inch in diameter, but the plates are absent.

Affinities and differences.—This species very much resembles the larger specimens of *Pseudodiadema depressum*, but the ambulacral tubercles appear to be proportionately smaller, and the ambulacral areas narrower than in that species; the bosses, likewise, are not so prominent, and the spinigerous tubercles are smaller; but from the weathered condition of the specimen, the only one known, it is impossible to make a more accurate comparison between these two nearly allied forms.

Locality and Stratigraphical position.—This urchin was collected from the Cornbrash at Caistor, Northamptonshire, by the late Miss Baker, and belongs to the British Museum Collection. It has been kindly communicated for this work by Mr. S. P. Woodward, who first described it in his excellent Notes on British Fossil Diademas, inserted in the 5th Decade of the 'Memoirs of the Geological Survey.'

PSEUDODIADEMA VAGANS, *Phillips*.

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| CIDARIS VAGANS. | Phillips, Geology of Yorkshire, pl. 7, fig. 1, 1829. |
| DIADEMA VAGANS. | Desmoulins, Études sur les Échinides, p. 316, 1835. |
| — — | Morris, Catalogue of British Fossils, 1843, p. 51. |
| — — | Morris, Catalogue of British Fossils, 2d edit., 1855, p. 72. |
| — — | Woodward, Memoirs of the Geological Survey, Decade V, Notes on Fossil Diademas. |
| PSEUDODIADEMA VAGANS. | Desor, Synopsis des Échinides Fossiles, p. 65. |

The type specimen of this species, with many other valuable fossils, was lost in 1835; there is, therefore, now some difficulty in making out the true form figured as *Cidaris vagans* in the 'Geology of Yorkshire.' Professor Phillips has, however, most kindly communicated, *ex memoriâ*, all the facts he recollects relating to this species, and has sent to me for comparison a Diadem which he collected at Whitwell, Yorkshire, from the Bath Oolite. In speaking of this urchin my friend observes—"It seems, except that it is larger, to revive my recollection of *Cidaris vagans*."

Having carefully compared this specimen with *Pseudodiadema depressum*, which it most nearly resembles, I find it agrees so well with that urchin in all its details which admit of comparison, that I believe it is referable to the same species; the under part of the test being imperfect, the base and mouth opening cannot be made out. The examination of the upper surface, and the poriferous zones, which are well preserved, has convinced me, that if it is regarded as a genuine example of Phillips's species, *Cidaris vagans* must be considered a synonym of *Pseudodiadema depressum*, Agassiz. My friend, Mr. John Leckenby of Scarborough, has kindly communicated two Diadems from the Great Oolite of the Nab rock; these urchins are nearly indetical with Prof. Phillip's Whitwell specimen; the pores in the upper part of the zones, in the Nab rock specimens, however, manifest a disposition to become slightly bigeminal, an irregularity which I have often seen in true unigeminal forms, and regard only as an occasional variety of the species. In all probability these urchins may represent *C. vagans*, as most of the Great Oolite Echinoderms are likewise found in the Cornbrash.

F. *Species from the Coralline Oolite.*[a. *Pores bigeminal in the upper part of the zones.*]PSEUDODIADEMA VERSIPORA, *Phillips*. Pl. VII, fig. 4 *a, b, c, d, e, f, g.*

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| DIADEMA VERSIPORA. | Woodward MS., Morris, Catalogue of British Fossils, 1st ed., 1843, p. 50. |
| — SUBANGULARE. | Agassiz, Description des Echinodermes Fossiles de la Suisse, pl. 17, figs. 21—25, p. 19. |
| — — | Wright, Annals and Magazine of Natural History, 2d series, vol. viii, p. 270. |
| DIPLOPODIA SUBANGULARIS. | M'Coy, Annals and Magazine of Natural History, 2d series, vol. ii, p. 412. |
| — — | Desor, Synopsis des Échinides Fossiles, p. 75. |
| DIADEMA VERSIPORA. | Woodward, Memoirs of the Geological Survey, Decade V. Notes on Fossil Diademas. |

Test circular, depressed; ambulacral areas with two rows of primary tubercles, fourteen in each row; poriferous zones undulated below; above the equator the pairs of pores form a double series; inter-ambulacral areas with primary and secondary tubercles; spines short, stout, pointed, covered with longitudinal lines.

Dimensions.—Height, nine twentieths of an inch; transverse diameter, one inch and a quarter.

Description.—This beautiful Diadem, which is so characteristic a fossil of the Coral Rag of England, was formerly mistaken for the *Cidarites subangularis*, Goldfuss. On comparing, however, a fine series of our urchins with a type specimen from the Coral Rag of Nattheim, sent by Professor Roemer, and a fine large specimen from the White Jura of Sigmaringen, kindly sent by Dr. Fraas, of Stuttgart, the difference is very evident. The Swiss *Diadema* figured by M. Agassiz, and considered to be identical with Goldfuss's species, agrees with our urchins in so many points of structure that I believe them to be identical. *P. versipora* has from twelve to fourteen primary tubercles in the inter-ambulacral areas, whereas *P. subangulare* has only from six to eight; the test, moreover, is higher and more circular, and there are more tubercles in each row in the ambulacral areas. I have, therefore, restored the manuscript name first given to this species by Professor Phillips, and afterwards adopted by Mr. Woodward.

Pseudodiadema versipora has the test depressed; in general it is circular; sometimes,

however, it inclines to a pentagonal form (fig. 4 *a*), in consequence of the prominence of the ambulacral areas, which are finely and regularly formed (fig. 4 *a, f*); they have two rows of primary tubercles on the margin of the areas, and in each row there are from twelve to fourteen tubercles, which are nearly as large as those in the inter-ambulacra; their summits are not deeply perforated, and they are raised on bosses with finely crenulated summits; in the middle third of the area there is a narrow miliary zone (fig. 4 *f*).

The poriferous zones, from the peristome to the equator, are slightly undulated (fig. 4 *b, c*); near the mouth they are arranged in triple oblique pairs (fig. 4 *c*), but above that point they are in single pairs (fig. 4 *f*); just above the equator, however, they form double pairs in the rest of the upper part of the zone (fig. 4 *a, d*); this diplopodous character is very constant in this species, and may be detected even in very young specimens.

The inter-ambulacral areas are nearly twice as wide as the ambulacral (fig. 4 *a, c*); they have two rows of primary tubercles, from twelve to thirteen in each row, and two rows of secondary tubercles on the ambulacral side of them (fig. 4 *c, e*). The primary tubercles are very uniform in size, and arranged with great regularity, those on the upper part being only a little less than those in the middle of the area (fig. 4 *d*); the tubercle is large (fig. 4 *g*), and only slightly perforated, so much so, that a little friction effaces the aperture; the bosses are small, and their summits are finely crenulated (fig. 4 *g*); the areolas are circular, or slightly inclined to an oval form; they are all confluent above and below (fig. 4 *f*), and the miliary zones form crescents of minute granules on their sides, so that the scrobicular circles are incomplete throughout. The miliary zone down the middle of the inter-ambulacra is broad in the middle, contracted below, and preserves its width above: it is composed of numerous minute granules, closely set together, among which an irregular row of larger granules extends up the middle thereof (fig. 4 *d, f*); about the upper third of the area the granules are absent from the middle of the zone, which is consequently naked (fig. 4 *d*); between the primary tubercles and the poriferous zones there is another miliary zone, about half as wide as that which occupies the centrosutural region; it is composed of like minute granules, among which a row of secondary tubercles are disposed in the basal region; five or six of these tubercles are about half the size of the primary tubercles in the same region, but from the equator upwards they are very small, and dwindle into granules (fig. 4 *e, f*).

The apical disc is absent in all the specimens I have examined; the opening is large and pentagonal, and the terminations of the areas where the disc was inserted are in many shells curved outwards (fig. 4 *a*). This peculiarity in the structure of the terminal plates may have rendered the union of the discal elements with them less firm than in other *Pseudodiademas*. "There appear to be two varieties of the species; one with the upper surface evenly inclined all round; the other tumid at the angles, and depressed in the centre above."—*Woodward*; a remark in which I entirely concur.

The mouth opening is nearly one half the diameter of the base (fig. 4 *b*); the peristome is decagonal and unequally lobed, the ambulacral lobes being one third larger than those

of the inter-ambulacral; the notches are deep, and their margins are much reflexed (fig. 4 *c*); the base is slightly concave in many specimens, in others it is almost flat.

The spines are well preserved *in situ* in a specimen in the British Museum, from which our figure (Pl. XII, fig. 7) is drawn; the primary spines in that urchin (fig. 7 *a, b*) are eleven twentieths of an inch in length; the stem is marked with longitudinal lines, the milled ring is not very prominent, and the spine may be said to be stout in proportion to its length; the secondary spines are one fifth of an inch in length, and are miniature forms of the primary spines. In some specimens, as one from Steeple-Ashton, kindly presented to me by Mr. Mackneil, of Wootton-under-Edge, the primary spines are swollen out, and slightly bent in the middle of the stem; the head and acetabulum are large, corresponding with the magnitude of the tubercles.

Affinities and differences.—This urchin was formerly identified with *Cidarites subangularis*, Goldfuss, but on comparing the German type of that species with ours, there can be no doubt of their distinctness. Goldfuss describes his species as having six or eight large tubercles in each row, with crenulated bosses in all the areas; the ambulacra are prominent, and the test is therefore pentagonal; each tubercle is surrounded with a circle of small granules. Now *Pseudodiadema versipora* has twelve primary tubercles in each row in the inter-ambulacral areas: the tubercles are consequently set close together, and all the areolas are confluent, so that each tubercle is not surrounded by a circle of small granules. It resembles *Cidarites subangularis* in possessing a double row of pores in the upper part of the poriferous zones, and in having a row of secondary tubercles between the primary tubercles and the pores. *Pseudodiadema versipora* very much resembles *Pseudodiadema subangulare*, Agassiz, which appears to be quite distinct from the *Cidarites subangularis*, Goldf.; in fact, the beautiful figures which Agassiz has given of the Swiss urchin leads me to think that it may be identical with our *Pseudodiadema versipora*. It has a greater number of tubercles in each row than the German species, in this respect resembling the English form; but, without the specimens were placed side by side, it would be impossible to speak positively on the point of their entire identity.

Pseudodiadema versipora is distinguished from *Pseudodiadema mamillanum*, which occurs with it in the same bed, by the double row of pores in the upper part of the zones, and by having secondary tubercles in the inter-ambulacral areas; the bosses are likewise smaller, and the tubercles are larger; the miliary zones are much wider, and the component granules are smaller.

Pseudodiadema versipora resembles *Pseudodiadema pentagona*, M'Coy, in having the pores in double pairs in the upper part of the zones; but it differs from that Great Oolite Diadem, which is a smaller, more depressed, and pentagonal form, in having larger primary and secondary tubercles, with a wider, and more granular miliary zone, in the centro-sutural region.

Pseudodiadema versipora resembles *Pseudodiadema depressum* in size and form, but is distinguished from it by having the pores in double pairs in the upper parts of the zones,

and by having secondary tubercles in the inter-ambulacra. From *Pseudodiadema hemisphæricum* it is distinguished by the primary tubercles in both areas being nearly of the same size, and by there being fewer in each row; by the secondary tubercles being limited to the poriferous side of the primary tubercles, and by the pores being arranged in double pairs in the upper part of the zones.

Locality and Stratigraphical position.—This species is found in the Coralline Oolite of Wiltshire, Oxfordshire, Dorsetshire, and Yorkshire. The finest specimens, however, are those of Wilts, where they are sometimes admirably preserved. In Switzerland the urchins which resemble our specimens have been collected from the “Terrain à Chailles,” of the valley of the Birse, of Blochmont, and of Weissenstein.

[b. Pores unigeminal in the upper part of the zones.]

PSEUDODIADEMA HEMISPHERICUM,* Agassiz. Pl. VIII, fig. 1 a, b, c, d, e, f.

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| CIDARITES PSEUDODIADEMA. | Lamarck, Animaux sans Vertèbres, tom. iii, p. 59, No. 17, 1st edit., 1816. |
| — — | Deslongchamps, Encyclopédie Methodique, tom. ii, p. 197, No. 17, 1824. |
| DIADEMA HEMISPHERICUM. | Agassiz, Prodromus Mém. Soc. des Sciences Nat. Neuchâtel, p. 22, 1836. |
| — TRANSVERSUM. | Agassiz, Prodromus Mém. Soc. des Sciences Nat. Neuchâtel, p. 22, 1836. |
| — PSEUDODIADEMA. | Agassiz, Echinodermes Fossiles de la Suisse, 2 ^e partie, t. 17, figs. 49—53, p. 11, 1840. |
| — LAMARCKII. | Desmoulins, Études sur les Échinides, p. 316, No. 18, 1837. |
| DIADEMA PSEUDODIADEMA. | Agassiz and Desor, Catalogue raisonné des Échinides Annales des Sciences Naturelles, 3 ^m e serie, tom. vi, p. 349, 1846. |
| — — | Bronn, Index Palæontologicus, p. 193, 1849. |
| — — | Alcide d'Orbigny, Prodrome de Paléontologie Stratigraphique universelle, tome ix, p. 27 14 ^e étage, No. 423, 1850. |

* M. Desor having selected the specific name “*pseudodiadema*,” originally given by Lamarck to this urchin, I have most reluctantly been obliged to adopt the name *hemisphæricum*, afterwards given by M. Agassiz to the same species, in order to avoid the double use of a specific name thus, *Pseudodiadema pseudodiadema*, Lamarck. This is one of the inconveniences arising from the modern practice of converting *specific* into *generic* names, an innovation in nomenclature which cannot be sufficiently discountenanced, for it leads, as in this case, to an injustice to the *original describer* of the species, whose name should always be associated with the form he first described, and introduces, moreover, a further confusion into the synonyms of species, a growing evil which every true naturalist should strive to the utmost to avoid.

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| CIDARIS DIADEMA. | Young and Bird, Geological Survey of the Yorkshire Coast, pl. 6, fig. 3, p. 212, 1828. |
| — MONILIPORA. | Phillips, Geology of Yorkshire, p. 127, 1829. |
| DIADEMA PSEUDODIADEMA. | Wright, Annals and Magazine of Natural History, 2d series, vol. viii, pl. 12, fig. 1 <i>a, b, c</i> , p. 271, 1851. |
| — — | Cotteau, Études sur les Échinides Fossiles du département de l'Yonne, pl. 17, fig. 1, p. 142, 1852. |
| — — | Salter, Memoirs of the Geological Survey, Decade V, pl. 2. |
| PSEUDODIADEMA HEMISPHERICUM. | Desor, Synopsis des Échinides Fossiles, t. 13, fig. 4, p. 68, 1854. |
| DIADEMA PSEUDODIADEMA. | Morris, British Fossils, 2d ed., p. 77, 1854. |

Test hemispherical, depressed on the upper surface, flat below; ambulacral areas with two marginal rows of primary tubercles, eighteen to twenty in each row; poriferous zones narrow, straight, with a moniliform line between the pores; inter-ambulacral areas with two rows of primary tubercles, fifteen in each row, and four rows of secondary tubercles, one row flanking each side of the primary rows; apical disc small, anal opening obliquely oblong. Mouth opening large, peristome decagonal, unequally lobed, and deeply notched; spines long and needle-shaped, finely sculptured with longitudinal lines.

Dimensions.—Height, one inch and one quarter of an inch; transverse diameter, two inches and four tenths of an inch.

Description.—Lamarck's description of his original *Cidarites pseudodiadema* was so meagre and ill defined, that great doubts were entertained by Desmoulins as to the urchin meant by the illustrious author of the 'Histoire Naturelle des Animaux sans Vertèbres;' and, unfortunately, M. Dujardin has added nothing in the new edition of that great work to the original text of this species. It would have been impossible for me to have identified it, had not my excellent friend M. Michelin sent me a small type specimen of Lamarck's species from the Coralline Oolite of Commercy Meuse, which is identical with our English forms of the same size.

Pseudodiadema hemisphaericum may justly be regarded as the type of the genus, exhibiting, as it does, the characters of the group in a most satisfactory manner. It appears, moreover, to have had a wide geographical range, as it is found in the same stage of the Coralline Oolites in Switzerland, in different departments of France, and in England.

When M. Agassiz published his 'Prodromus,' he was unacquainted with the original of Lamarck's species, a subsequent comparison of specimens, however, convinced him that the urchin he had collected in the Swiss Jura, and named *Diadema hemisphaericum*, was identical with *Diadema pseudodiadema*, Lamarck, and that his *Diadema transversum* was merely a distorted form of the same urchin.* It is probable that *Diadema*

* 'Description des Echinodermes Fossiles de la Suisse,' partie 2^e, p. 12.

ambiguum, Desmoulins, from the Terrain Jurassique Ardennes, is another name for the same form, but nothing can be stated positively on this point, as Desmoulins's note on this species is evidently written with much hesitation. M. Desor, in taking the name *Pseudodiadema* to designate his genus, has retained the specific name *hemisphaericum* for Lamarck's species; whilst M. Cotteau has figured and described a Corallian *Pseudodiadema* under that name, which he considers to be distinct from it.

This fine large urchin has a hemispherical form; it is depressed above and flat below, almost entirely circular at the circumference, and rarely having a pentagonal form (Pl. VIII, fig. 1 *a*, *b*). The ambulacral areas have two rows of marginal tubercles, which are smaller, and placed more closely together, than those of the inter-ambulacral areas; they are largest at the equator, and diminish rapidly in size in the upper parts of the areas, so that, when viewed at the equator, the primary tubercles of both areas are nearly of equal size (fig. 1 *c*), whilst above, those of the ambulacra are disproportionately small when compared with those of the inter-ambulacra (fig. 1 *a*); there are twenty tubercles in each row, with a zigzag line of small tubercles, extending two thirds up the areas (fig. 1 *d*); the poriferous zones are straight (fig. 1 *a*, *c*, *d*); the pores are small and unigeminal throughout, except at the base, where a few are bigeminal (fig. 1 *b*), and near the peristome, where some are trigeminal (fig. 1 *f*); the septa between the two holes forming a pair are elevated, and these elevations form a moniliform line, which extends down the centre of the zone, separating the pores from each, and defining the boundaries of the areas (fig. 1 *d*); there are five pairs of holes opposite each of the large inter-ambulacral plates (fig. 1 *d*).

The inter-ambulacral areas are more than twice the width of the ambulacral (fig. 1 *a*, *b*, *c*, *d*); they are furnished with two rows of primary tubercles, having fifteen or sixteen in each row, which have their greatest development at the equator, and gradually diminish as they approach the apical disc (fig. 1 *a*), and the peristome (fig. 1 *b*); the primary are flanked on each side by one or more rows of secondary tubercles down the centre of the area (fig. 1 *c*, *d*); the military zone consists of two rows of secondary tubercles, which separate the primary rows from each other (fig. 1 *d*), and two rows of secondary tubercles separate the primaries from the poriferous zones (fig. 1 *d*); the secondary tubercles are very irregular in their size and arrangement; they are best developed at the base and equator of the test (fig. 1 *b*, *c*); besides the primary and secondary tubercles just described, the surface of the plates is covered with numerous granulations, which form circles, more or less complete, about the base of the tubercles (fig. 1 *d*).

The tubercles of both areas, at and near the equator, are raised on prominent bosses, the summits of which are all finely crenulated; the base is surrounded by a narrow areola, around which small granules and minute tubercles form more or less complete scrobicular circles (fig. 1 *d*); the areolas at the equator are all confluent above and below, whilst those in the upper part of the areas are nearly, if not quite, complete (fig. 1 *a*).

It is remarkable how often the apical disc of this species is preserved *in situ* (fig. 1 *a*);

the genital plates are of a pentagonal form (fig. 1 *e*) ; the anterior pair are the largest, and the right antero-lateral, supporting the madreporiform body, is much larger than the left antero-lateral ; the postero-lateral and single plates are about the same size ; the genital holes are small, and pierced near the external prominent angle of the plates ; the ocular plates are small, heart-shaped bodies, placed at the summits of the ambulacra, which they terminate ; the eye hole is marginal, and proportionally large ; the anal opening is oblong, its longest diameter extending obliquely across the test ; the surface of all the elements of the apical disc is covered with small, nearly equal-sized granules.

The base is flat (fig. 1 *c*), the mouth opening is large, being more than one half the diameter of the base ; the peristome is decagonal, and divided into ten lobes by deep notches, the ambulacral being much larger than the inter-ambulacral lobes (fig. 1 *b*).

The spines are not preserved in any English specimens I have seen. Those figured *in situ*, by Agassiz, are long and needle-shaped, and their surface is covered with fine longitudinal lines.

Affinities and differences.—*Pseudodiadema hemisphæricum* differs so much from all our other English species of this genus, that it is impossible to mistake it for either of them. Some juvenile specimens, however, have an air of resemblance to *Hemicidaris pustulosa*, arising from the disproportionate size between the tubercles at the base and equator of the ambulacra, and those occupying the upper portion of these regions ; but the presence of secondary tubercles in the inter-ambulacra, flanking both sides of the primary tubercles, serves as a diagnostic character, no *Hemicidaris* having any secondary tubercles in the inter-ambulacral regions ; moreover, the number of the primary tubercles in each row is considerably more in *Pseudodiadema hemisphæricum* than in *Hemicidaris pustulosa*.

Lamarck's species is distinguished, according to M. Cotteau, from the urchin figured by him under the name *Diadema hemisphæricum*, "d'une manière positive et constante, par ses tubercles secondaires plus développés, plus nombreux, et plus régulièrement disposés au milieu des aires inter-ambulacraires ; il s'en distingue également par les entailles plus profondes de son ouverture buccale."*

Pseudodiadema hemisphæricum, Agass., resembles *Pseudodiadema Orbignyianum*, Cotteau, but the latter is readily distinguished from it by the greater number, regularity, and uniformity of its secondary tubercles, and the smaller size of the primary tubercles. These three species, which are all characteristic of the Coral Rag, resemble each other very much, and are only distinguished by the number and disposition of their secondary tubercles, which are rare in *Pseudodiadema hemisphæricum*, Cotteau, more numerous in *Pseudodiadema hemisphæricum*, Agass., and very abundant in *Pseudodiadema Orbignyianum*, Cotteau.

Locality and Stratigraphical position.—This species is very rare in the Coralline

* 'Études sur les Échinides Fossiles,' p. 144.

Oolite of Wilts. The specimen figured in Pl. VIII, fig. 1, was collected in the neighbourhood of Calne. It is more abundant in the Coralline Oolite of Yorkshire. Many fine specimens having been obtained from Malton and its vicinity. Its foreign distribution occupies a wide area in France. It is found in the "Corallien étage of Besançon, Saint-Mihiel, La Rochelle, Druyes (Yonne), and Commercy (Meuse);" and in Switzerland in the neighbourhood of Soleure. It is everywhere a very characteristic fossil of the Coral Rag.

PSEUDODIADEMA RADIATA, *Wright*, nov. sp. Pl. VII, fig. 3 *a, b, c, d, e, f*.

Test circular, depressed, inflated at the sides; ambulacral areas narrow, with two rows of primary tubercles, twelve in each row, rather smaller than those of the inter-ambulacra; poriferous zones straight, pores unigeminal throughout; inter-ambulacral areas with two rows of primary tubercles, twelve in each row, separated by a wide miliary zone filled with several rows of granules; base concave, mouth opening small, peristome unequally decagonal.

Dimensions.—Height, rather more than seven twentieths of an inch; transverse diameter, nine tenths of an inch.

Description.—The test of this species is circular, and nearly equally depressed on the upper and under surface (fig. 3 *c*); the sides are rather tumid, and the ambulacral tubercles are only a little smaller than those of the inter-ambulacral. The ambulacral areas form no prominence on the sides as in so many other *Pseudodiademas* (fig. 3 *a*); they are more than half the width of the inter-ambulacral; and are occupied by two rows of primary tubercles (fig. 3 *d, e*), of which there are twelve in each row; their bosses are small, and set closely together, and their summits have well-marked crenulations (fig. 3 *f*); down the centre of the area there is a single zigzag line of granules, which becomes double about the middle of the area; transverse branches of granules separate the areolas; the tubercles are of a very uniform width throughout, and diminish gradually in size towards both ends of the area.

The poriferous zones are narrow, and nearly straight, and the pores are unigeminal throughout; the pores forming a pair are contiguous, with thin septa; there are three pairs of pores opposite the ambulacral plates, and four pairs of pores opposite one of the inter-ambulacral plates (fig. 3 *f*).

The inter-ambulacral areas are not quite twice the width of the ambulacral; they have two rows of primary tubercles, of which there are twelve in each row (fig. 3 *d*); each plate (fig. 3 *f*) is occupied by a wide areola, the boss is not prominent, its summit is marked with twelve crenulations, and the spinigerous tubercle is small, flat, and finely perforated

(fig. 3 *f*); between the areola and the pedal pores there is a narrow lateral miliary zone, formed of two rows of small granules, among which two or three small secondary tubercles are interspersed (fig. 3 *f*); the central miliary zone is wide; on each plate there are two rows of small, close-set granules (fig. 3 *f*), making four rows of granules at the equator; a little way above that point they bifurcate, and on the upper part of the area a few scattered granules only are observed, the surface of the plates being almost naked (fig. 3 *d*). Like the ambulacral tubercles, those of the inter-ambulacra diminish very gradually in size towards both ends of the area.

The base is slightly concave, from the tumidity of the sides of the test; the mouth opening is small (fig. 3 *b, e*), four tenths of an inch in diameter; the peristome is slightly notched, the ambulacral lobes being larger than the inter-ambulacral (fig. 3 *e*).

The disc opening is nearly round, but the plates are unfortunately absent.

Affinities and differences.—This species resembles *Pseudodiadema mamillanum*, Roemer, in having a few small secondary tubercles near the base, between the poriferous zones and the primary tubercles, and in having the pores unigeminal; but it is readily distinguished from that fine species by having smaller tubercles, much less prominent bosses, and a wider miliary zone; the sides of the test are likewise much more tumid, the mouth opening is smaller, and the peristome is more equally lobed.

From *Pseudodiadema versipora*, which occurs with it in the same rock, it is readily distinguished by the unigeminal character of its poriferous zones, and the absence of large secondary tubercles from the inter-ambulacral plates (Pl. VII, fig. 4 *f*).

Locality and Stratigraphical position.—This is a very rare species; it was collected from the Coral Rag, near Steeple Ashton, Wilts, associated with *Pseudodiadema versipora*.

PSEUDODIADEMA MAMILLANUM, *Roemer*. Pl. VIII, fig. 2 *a, b, c, d*; Pl. XII, fig. 9.

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| CIDARITES MAMILLANUM. | Roemer, die Versteinerungen des Norddeutschen Oolithen-Gebirges, t. 2, fig. 1 <i>a, b, c</i> , p. 26. |
| DIADEMA MAMILLANUM. | Agassiz and Desor, Catalogue raisonné Annales des Sciences Naturelles, 3 ^m e série, Zool., tom. vi, p. 347. |
| — SPINOSOSUM. | Agassiz, Catalogus Systematicus, p. 8. |
| — DAVIDSONII. | Wright, Annals and Magazine of Natural History, 2d series, vol. xiii, p. 170, pl. 13, fig. 2 <i>a—e</i> . |
| — MAMMILLATUM. | D'Orbigny, Prodrome de Paléontologie, tome ii, p. 27, 14 ^e étage Corallien. |
| PSEUDODIADEMA MAMILLANUM. | Desor, Synopsis des Échinides Fossiles, p. 64. |
| DIADEMA MAMILLANUM. | Woodward, Memoirs of the Geological Survey, Decade V. Notes on British Fossil Diademas. |

Test circular, depressed; ambulacral areas wide, with two rows of primary tubercles nearly as large as the inter-ambulacral; poriferous zones narrow; pores unigeminal on the sides and upper part of the zones, trigeminal near the mouth; inter-ambulacral areas with two rows of primary tubercles, and two short rows of secondary tubercles on the zonal sides of the primaries; the bosses of both areas nearly of the same size, large, prominent, and conical; spinigerous tubercles of both areas of the same size, large, and widely perforated. Mouth opening large, peristome decagonal, ambulacral lobes twice the width of the inter-ambulacral; spines long, round, stout, and covered with longitudinal lines.

Dimensions.—Height, nine twentieths of an inch; transverse diameter, one inch and three tenths.

Description.—This Diadem was first discovered in the Coral Rag of Hildesheim, and figured and described by M. Roemer in his work on the ‘Oolitic Fossils of Northern Germany;’ it has subsequently been found in the Coralline Oolites of France. When I found this species, some years ago, in the Coral Rag of Wiltshire, I was then unable to identify it with any published species, and figured and described it in the ‘Annals of Natural History’ under the name *Diadema Davidsonii*, M. Roemer’s figure being very indistinct, and without details, did not furnish sufficient data for identification. Since the publication of that paper, M. Desor has compared my figures and descriptions with the moulds in the Museum of Neuchâtel, attributed to *Diadema mamillanum*, and he says, “n’ai pas trouvé de raison suffisante pour les distinguer.*” Mr. Woodward† states that “the British forms of this species agree perfectly with specimens received from Dr. Roemer, labelled U. Coral Rag, Hildesheim, Hanover.” There is, therefore, no doubt that *Diadema Davidsonii* is identical with Roemer’s species.

This beautiful urchin has a regular cylindrical test, not at all inclined to the pentagonal form of many of its congeners (fig. 2 *a*, *b*); the ambulacral areas are about three fourths the width of the inter-ambulacral, and nearly of a uniform breadth throughout, tapering gracefully inwards towards their superior third (fig. 2 *a*); the contraction assumes the form of a gentle curve, slightly inclined towards the centre. The double row of tubercles, which are nearly as large as those of the inter-ambulacra, gradually increase in size from the peristome to the equator, where three pairs are about the same size; from this point upwards they gradually decrease, and terminate in two pairs of minute rudimentary tubercles near the apical disc. A single row of granules, arranged in a zigzag form, separates the two rows of primary tubercles from each other, a larger granule marking each re-entrant angle (fig. 2 *d*); the areolas abut against the poriferous zones (fig. 2 *d*), without the intervention of any granules between these eminences and the pores.

* Desor, ‘Synopsis des Échinides Fossiles,’ p. 64.

† ‘Memoirs of the Geological Survey,’ Decade V. Notes on British Fossil Diademas.

The poriferous zones are very narrow; the pores are contiguous, and unigeminal throughout (fig. 2 *d*), except at the wide inter-tubercular spaces around the mouth, where they fall into triple oblique pairs (fig. 2 *b*); in the upper third of their course, the zones curve slightly inwards, and the pores are set very closely together in this region. There are five pairs of pores opposite each inter-ambulacral plate, and nearly a like number opposite the ambulacral plates (fig. 2 *d*).

The inter-ambulacral areas are four tenths of an inch in width, and only one fourth wider than the ambulacral areas. They retain their breadth very uniformly throughout, and are occupied by two rows of primary tubercles, of which there are ten in each row; the bosses are large and prominent; those at the equator occupying nearly the entire surface of the plates (fig. 2 *d*); their summits are sharply crenulated, and the spinigerous tubercle is widely perforated; from the peristome to the equator (fig. 2 *b*, *d*), or for about two thirds the length of the area, there is a row of small secondary tubercles between the zones and the primaries, which are raised on mammillated bosses, with crenulated summits (fig. 2 *d*); the miliary zone is narrow, and composed only of two rows of granules, which descend down the tract of the zigzag central suture (fig. 2 *d*), there being five granules on each plate (fig. 2 *d*).

The tubercles of both areas stand prominently out from the surface of the test, in consequence of the size of the mammillary bosses, which are unusually conical in this species; from the mouth to the equator the tubercles of both areas are nearly alike in size and number (fig. 2 *b*, *c*), but on the upper part of the test those of the ambulacral areas become much smaller and more numerous (fig. 2 *a*) than those of the inter-ambulacral areas.

The mouth opening is wide, about eleven twentieths of an inch (fig. 2 *b*); the peristome is decagonal, and unequally lobed, the ambulacral being twice as large as the inter-ambulacral lobes. Since Pl. VIII was printed, I have obtained a slab with the test and spines *in situ* thereon, and which is figured in Pl. XII, fig. 8. The primary spines (fig. 8 *a*, *b*) are nine tenths of an inch in length; the head is well defined by a prominent milled ring; the stem, which is cylindrical, tapers uniformly from the ring to the point, which is rather blunt, and the surface is covered with fine longitudinal lines; the secondary spines (fig. 8 *c*) are nearly three twentieths of an inch in length, and are miniature representatives of the primaries.

The disc opening is wide (Pl. VIII, fig. 2 *d*); its form cannot be described, as the plates around its margin are more or less fractured. The discal elements are lost in all the specimens I have yet seen.

Affinities and differences.—The great width of the ambulacral areas, and the uniformity in the size and number of the primary tubercles at the base and equator of the test (fig. 2 *b*, *c*, *d*), render the diagnosis between this species and its congeners easy and decisive.

From *Pseudodiadema versipora* it is distinguished by the unigeminal character of its poriferous zones, the greater prominence of its bosses, the smaller size of its tubercles, the greater width of the ambulacral areas, and the narrowness of its miliary zones. From *Pseudodiadema radiata*, which has likewise unigeminal pores, by the size of the bosses and the narrowness of the miliary zones, and the absence of the lateral tumidity which characterises that species. From *Pseudodiadema hemisphaericum* it is distinguished by the uniformity in size between the ambulacral and inter-ambulacral tubercles, which are very unequal in that large species; and by the smallness of the secondary tubercles, and their limitation to the zonal sides of the area; whereas the secondary tubercles are developed on both sides of the primaries in *Pseudodiadema hemisphaericum*, a character which forms a good diagnosis between these two Coralline Oolite forms.

Locality and Stratigraphical position.—I have collected this species in the Clays and Limestones of the Coralline Oolite, at Calne, Wilts, associated with *Hemicidaris intermedia*, *Acrosalenia decorata*, *Echinus gyratus*, and *Echinobrissus scutatus*. On many slabs all these species are sometimes found clustered together in a more or less fragmentary condition. It has been collected from the Coral Rag, at Redcliff, near Weymouth; specimens from this locality are in the British Museum, and Geological Museum, Jermyn Street.

On the Continent, it has been collected by M. Roemer from the Upper Coral Rag of Hildesheim, Hanover, and in the “Corallien étage de la Rochelle, de Verdun, France.”—*Desor*. It is everywhere a rare species.

History.—First described and figured by M. Roemer under the name *Cidarites mamillanum*; afterwards figured and described as *Diadema Davidsonii*, in the ‘Annals of Natural History.’ But a comparison of the English with the Foreign types has proved them to be identical.

NOTES

ON FOREIGN JURASSIC SPECIES OF THE GENUS PSEUDODIADEMA NEARLY ALLIED TO
BRITISH FORMS, BUT WHICH HAVE NOT YET BEEN FOUND IN THE ENGLISH OOLITES.

A. *Pores unigeminal in the upper part of the zones ; no secondary tubercles.*

PSEUDODIADEMA SUBCOMPLANATUM, *d'Orbigny*. Prodrôme de Paléontologie, p. 319.

Test small, depressed, pentagonal ; tubercles of both areas at the base, and equator of the test proportionately large, prominent, and equal sized ; ambulacra prominent, with eight or nine tubercles in each row, nearly as large, but more crowded together at the base and equator ; diminishing more rapidly in size in the upper part of the area than those of the inter-ambulacra. Inter-ambulacral areas with eight rows of large prominent primary tubercles, and four small secondary ones on their zonal sides at the base ; miliary zone narrow, with two rows of granules ; nearly related to *P. complanatum*, Agass., and to *P. depressum*, Agass. It differs from the former in having a much larger mouth-opening, and from the latter in having larger tubercles, a narrower miliary zone, and four small secondary tubercles at the base.

Dimensions.—Height, three tenths of an inch ; transverse diameter, four fifths of an inch.

Formation.—Grande Oolite, 11^e étage Bathonien, de Ranville, Luc (Calvados).

Collections.—Deslongchamps, Michelin, d'Orbigny, my Cabinet.

PSEUDODIADEMA COMPLANATUM, *Agassiz*. Syn. *Diadema complanatum*, Agass., Echinod.
Suisse, part ii, tab. 17, fig. 31—35.

Test small, very much compressed ; the ambulacral are smaller than the inter-ambulacral tubercles, and they diminish more rapidly in size at the upper surface, but in

other parts those of each area very much resemble one another; there are fewer tubercles in a row in the ambulacra than in the inter-ambulacra; the poriferous zones are narrow, and the pores are unigeminal on the upper surface; the mouth opening is small, and the decagonal peristome is divided into nearly equal-sized lobes; there are no secondary tubercles at the base of the inter-ambulacra.

Dimensions.—Height, three twentieths of an inch; transverse diameter, two fifths of an inch.

Formation.—"Portlandien inférieure (Astartien) de Rædersdorf (Haut Rhin), du Jura Neuchâtelois, des bords du Doubs, de Laufen.

Collections.—MM. Gresly, Thurmann. Desor. Rare."

PSEUDODIADEMA INÆQUALE, *Agassiz*. Syn. *Diadema inæquale*, Agassiz, Cat. syst., p. 8.

Test small, subpentagonal, and depressed; tubercles small, uniform, and numerous; inter-ambulacral tubercles arranged near the poriferous zones; miliary zone wide, and naked from the equator to the apical disc; mouth opening of moderate size; peristome divided into equal-sized lobes; opening for the disc large, and oblong; the approximation of the tubercles into groups of four rows, separated by the wide naked miliary zone in the upper part of the areas, serves to distinguish this species from allied forms. It differs from *P. superbum* in having the tubercles set closer together, and from *P. textum* in having wider ambulacral areas.

Dimensions.—Height, two fifths of an inch; transverse diameter, four fifths of an inch.

Formation.—Kellovien de Marolles, de Chaufour, et Montbizot (Sarthe), Lifol (Vosges). Common.

Collections.—MM. Michelin, d'Archiac, d'Orbigny. The specimens in my Cabinet were kindly sent me by M. Triger, of Le Mans.

PSEUDODIADEMA SUPERBUM, *Agassiz*. Syn. *Diadema superbum*, Agass., Echinod. Foss. de la Suisse, tab. 17, fig. 6—10, p. 23, part ii.

Test small, subpentagonal, and sometimes inflated at the sides; ambulacral tubercles

smaller than the inter-ambulacral, diminishing rapidly in size on the upper part of the areas; inter-ambulacra with two rows of primary tubercles, but no secondary ones; areolas surrounded by complete circles of small granules; miliary zone wide, with fine granulations at the equator, but naked at the upper part; mouth-opening small, situated in a concavity; discal opening large and oblong. This species very much resembles *P. inæquale*, and it may be only a small variety of that Kellovian form.

Dimensions.—Height, one quarter of an inch; transverse diameter, half an inch.

Formation.—Oxfordien marnes, des Vaches-noires, Calvados; de Mont Vohayes, Jura Bernois, de Belfort.

Collections.—Museum Paris, Coll. MM. Gresly, Michelin, my Cabinet.

PSEUDODIADEMA MAGNAGRAMMA, *Wright*, nov. sp. Davidson's MSS., pl. 3 bis, figs. 4—6.

Test circular depressed, with two rows of tubercles in the inter-ambulacra; ambulacra two thirds the width of the inter-ambulacra; tubercles of both areas set on bosses, with a very large base; those of the ambulacra are a little smaller than those of the inter-ambulacra; the ranges of tubercles in both areas are separated by a single row of small granules; the discal opening is small, and the mouth opening is concealed; there are no secondary tubercles, and the pores are strictly unigeminal.

Dimensions.—Height, nine twentieths of an inch; transverse diameter one inch and one twentieth of an inch.

Formation.—Collected from the Portland beds, between Portel and Equihen, Boulonnais.

Collections.—Mr. Davidson, M. Bouchard Chantereaux, my Cabinet.

B. *Pores unigeminal in the upper part of the zones, with two or four rows of secondary tubercles in the inter-ambulacra.*

PSEUDODIADEMA PLACENTA, *Agassiz*. Syn. *Diadema placenta*, Agassiz, Echinod. Foss. Suisse, tab. 17, figs. 16—20.

Test circular, much depressed on the upper and under surfaces ; tubercles nearly the same size in both areas ; areolas surrounded by a circle of granules ; four rows of small secondary tubercles between the peristome and the equator ; mouth opening of moderate width ; peristome not deeply notched.

Dimensions.—Height, eleven twentieths of an inch ; transverse diameter, one inch and nine twentieths.

Formation.—"Corallien inférieure (Terrain à chailles) du Fringeli (Canton de Soleure), de Nantua, des environs de Salins, de Druyes (Yonne)." Desor.

Collections.—Museum Neuchâtel, Coll. MM. Gressly, Marcou, Cotteau. Common.

PSEUDODIADEMA ORBIGNYANUM, *Cotteau*. Syn. *Diadema Orbignyanum*, Cotteau, Échinides Foss., tab. 17, fig. 2—6.

Test circular hemispherical, flattened at the base, and depressed on the upper surface ; ambulacra narrow, with two rows of primary tubercles ; inter-ambulacra with two rows of primary tubercles, and six or eight rows of small equal-sized secondary tubercles ; the primary tubercles of both areas are about the same size ; those of the inter-ambulacra are closely surrounded by numerous secondary tubercles ; apical disc small, genital plates narrow ; poriferous zones narrow ; pores falling into triple oblique pairs near the mouth, but strictly unigeminal above ; mouth opening large ; peristome deeply notched ; lobes very unequal.

Dimensions.—Height, nine twentieths of an inch ; transverse diameter, one inch and seven tenths of an inch.

Formation.—Corallien de Coulanges sur Yonne, Druyes, et Chatel-Censoir, (Yonne), Profont (Ain), Hobel (Canton de Soleure).

Collections. — Museum Bâle, Coll. MM. Cotteau, Renevier. Plaster mould, my Cabinet.

PSEUDODIADEMA TETRAGRAMMA, *Agassiz*. Syn. *Diadema tetragramma*, Agass., Echinod. Foss. Suisse, tab. 17, figs. 39—43.

Test circular, hemispherical, depressed ; inter-ambulacra with four rows of secondary

tubercles, which at the base, and up to the equator, nearly equal in size the two rows of primary tubercles; this imparts a tetragrammous appearance to this species, which is lost, however, in the upper part of the area, where there are only two rows of tubercles; ambulacra moderately wide, their tubercles nearly as large as those of the inter-ambulacra; pores unigeminal throughout; apical disc small and ring-like, all the plates covered with a fine granulation; rows of small granules separate the areolas from each other; mouth opening large; peristome not deeply notched.

Dimensions.—Height, nine twentieths of an inch; transverse diameter, one inch and one twentieth of an inch.

Formation.—Corallien de Bensançon, de Chatel-Censoir (Yonne).

Collections.—Museum of Vienna (Collection Dudressier), Coll. M. Cotteau. Very rare.

PSEUDODIADEMA ÆQUALE, *Agassiz*. Syn. *Diadema æquale*, Agass., Echinod. Foss. Suisse, part ii, tab. 17, figs. 36—38.

Test circular hemispherical, depressed above; ambulacral rather smaller than the inter-ambulacral tubercles; areolas confluent; four rows of small secondary tubercles, which only extend to the equator; upper part of the miliary zone naked; mouth opening moderately large; peristome not deeply notched; pores strictly unigeminal, falling into triple oblique pairs near the mouth. This species very much resembles *P. hemisphæricum*, but the smallness of the secondary tubercles, the shortness of the rows, and the nakedness of the upper part of the miliary zone, distinguish it from that allied form.

Dimensions.—Height, eleven twentieths of an inch; transverse diameter, one inch and two fifths.

Formation.—Argovien des environs d'Arau. Kellovien des environs de Quingey.

Collections.—Museum Bâle, Coll. Zschokke, Marcou. Very rare.

PSEUDODIADEMA AFFINE, *Agassiz*. Syn. *Diadema affine*, Agass., Echinod. Foss. Suisse, part ii, tab. 17, figs. 54—58.

Test small, circular, depressed; the secondary tubercles at the zonal sides of the

primaries nearly equal the latter in size ; those near the centro-suture are much smaller ; miliary zone covered with small granulations above ; pores strictly unigeminal ; areolas confluent at the equator, separated by small granules above ; mouth opening small : peristome scarcely notched.

Dimensions. — Height, three tenths of an inch ; transverse diameter, seventeen twentieths of an inch.

Formation. — “ Jura supérieur du Dèpt. du Doubs. Très rare.” Desor.

Collection. — Museum Neuchâtel, Coll. Renaud-Comte (Musée Besançon).

PSEUDODIADEMA PLANISSIMUM, *Agassiz*. Syn. *Tetragramma planissimum*, Agass., Echinod. Foss. Suisse, part ii, tab. 14, figs. 1—3.

Test small, circular, very much depressed ; inter-ambulacra with four rows of secondary tubercles, which at the base and equator equal the two rows of primary tubercles in size ; these divisions of the test therefore support six rows of equal-sized tubercles ; in the upper part of the area the secondary tubercles become much smaller ; ambulacra with two rows of tubercles as large as those in the inter-ambulacra ; miliary zone very narrow ; mouth opening small ; peristome scarcely notched.

Dimensions. — Height, one fifth of an inch ; transverse diameter, four fifths of an inch.

Formation. — “ Portlandien moyen (Calcaire à Tortues) de Soleure. Marnes Strombiennes de Porrentruy.” Desor.

Collection. — Museum Neuchâtel, Coll. Gressly, Thurmann. Very rare.

C. Pores bigeminal in the upper part of the zones ; inter-ambulacra with two rows of secondary tubercles.

PSEUDODIADEMA SUBANGULARE, *Goldfuss*. Syn. *Cidarites subangularis*, Goldfuss, Petrefacta, Germaniæ, tab. 40, fig. 8.

Test pentagonal, depressed ; ambulacra one half the width of the inter-ambulacra, with two rows of tubercles 10 or 12 in each row ; inter-ambulacra with two rows of primary tubercles 10 or 12 in each row, and two rows of small secondary tubercles on the zonal sides of the primaries, extending three fourths of the length of the area ; bosses small

and sharply crenulated; primary tubercles of both areas nearly of the same size, large, round, and prominent; areolas narrow, and encircled with small, round, spaced-out granules; poriferous zones narrow; pores bigeminal in the upper part of the zones; miliary zone of moderate width, with a few granules at the equator, but naked in the upper part of the area; mouth opening less than one half the diameter of the test; peristome decagonal, divided by notches into nearly equal-sized lobes.

Dimensions.—Height, three fifths of an inch; transverse diameter, one inch and a half.

Formation.—Coral Rag of Nattheim and Sigmaringen, Württemberg; of Thurnau and Muggendorf, Bavaria; of Galgenberg, near Hildesheim, and Lindenberg, near Hanover; of Chatel-Censoir and Druyes, (Yonne); Argovien? of Randen; “Oxfordien à *Belemnites hastatus* du Jura Neuchâtelois.” Desor.

Collections.—In all the Foreign Collections of Jurassic Fossils. The specimen whence the diagnosis given above has been drawn, was sent me by Dr. Fraas of Stuttgart, as a type of Goldfuss’s species. It was collected from the White Jura δ and ϵ of Sigmaringen.

In this specimen the pores are unigeminal in the upper part of the zones, as in the one figured by Goldfuss; but as several plates belonging to the upper part of the areas are absent, and the pores at the same time are much concealed by the matrix, the bigeminal arrangement may nevertheless have existed in this specimen. In another small Diadem from the Coral Rag of Nattheim, sent me by Professor Roemer, from the Bonn Museum, as typical of Goldfuss’s species, the pores are distinctly bigeminal; in a third specimen, from the Coral Rag of Druyes, sent by M. Cotteau, the pores are likewise bigeminal. I have not cited the specimens so beautifully figured as *Diadema subangulare*, by M. Agassiz,* because they certainly are not identical with Goldfuss’s type; they more probably belong to *Pseudodiadema versipora* of the English Coral Rag. Mr. Woodward† says, “We cannot agree with M. Agassiz in considering either of these forms referable to the ‘*Cidarites subangularis*’ of Goldfuss; German specimens agreeing with Goldfuss’s figure and description, in the presence of only a single series of pores, are in the British Museum.” Whether the diplopodous forms are only a variety, or a distinct species, it is impossible to decide, without a better series of specimens for comparison than I possess at present.

* ‘Echinodermes Fossiles de la Suisse,’ part ii, pl. 17, figs. 21—25.

† Notes on British Fossil Diademas. ‘Mem. of the Geological Survey,’ Decade V.

Genus—HEMIPEDINA, *Wright*. 1855.

This rare genus is composed of neat and highly ornamented urchins, in general much depressed on their upper surface, and with a flat or slightly concave base. The ambulacral areas are narrow and straight; the pores in the poriferous zones are arranged in single pairs; the inter-ambulacral areas are, in general, more than double the width of the ambulacral, with two, four, six, or eight rows of tubercles, arranged in general abreast on the same tubercular plate.

The tubercles are perforated, and set on bosses with smooth, uncrenulated summits; one row of tubercles extends from the peristome to the disc; the other rows, when there are four and six rows in the area, stop short at the equator, or between the equator and the disc; the upper part of the miliary zone is therefore in general wide, and covered with a fine granulation.

The apical disc is large; the genital plates are expanded and foliated; the eye holes are perforated in the centre of the ocular plates, which are large.

The mouth opening is of moderate dimensions, and the peristome is divided into ten nearly equal-sized lobes.

The spines are long, slender, and needle-shaped; those that are known equal in length the diameter of the test, and their surface is sculptured with delicate, longitudinal lines.

Hemipedina is related to *Pseudodiadema* in having the pores unigeminal, and the tubercles perforated; but is distinguished from *Pseudodiadema* by the absence of crenulations from the summits of the bosses.

It is related to *Pedina* in possessing perforated and uncrenulated tubercles; but is distinguished from that genus in having the pores unigeminal (*Pedina* having the pores trigeminal like *Echinus*); the elements of the apical disc are likewise more largely developed.

Hemipedina is related to *Echinopsis* in possessing uncrenulated and perforated tubercles, with unigeminal pores; but is distinguished from *Echinopsis* by the narrowness of the ambulacral areas, the general depressed form of the test, the shape of the mouth opening, and the deep decagonal lobes of the peristome (that of *Echinopsis* being almost deprived of incisions), together with the greater size and development of the elements of the apical disc.

Hemipedina, as far as we at present know, is composed of Oolitic species which commenced in the Lower Lias, and extended into the upper division of the Oolites, each stage possessing its own specific forms.

A. *Species from the Lias.*HEMIPEDINA BECHEI, *Broderip*. Pl. IX, fig. 1 *a, b*.

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|--------------------|---|
| CIDARIS BECHEI. | Broderip, Geological Proceedings, vol. ii, p. 202. |
| DIADEMA BECHEI. | Morris, Catalogue of British Fossils, 1st edition, p. 51. |
| — — | Morris, Catalogue of British Fossils, 2d edit., p. 76. |
| ECHINOPSIS BECHEI. | Woodward, Memoirs of the Geological Survey, Decade V. Notes on Fossil Diademas. |
| HEMIPEDINA BECHEI. | Wright, Annals and Magazine of Natural History, 2d series, vol. xvi, p. 96. |

Test small, much crushed, and covered over with spines; ambulacra with two rows of tubercles; inter-ambulacra with four or six rows of tubercles; spines long, slender, and needle-shaped, four fifths of an inch in length, with longitudinal lines on their surface.

Description.—The test of this specimen, and the one in the collection of the Geological Society, which appears to belong to the same species, is so much covered up with spines and adherent matrix, that it cannot be sufficiently developed to show the details of its structure. The ambulacral areas have two rows of small tubercles placed on the margins of the plates; and the inter-ambulacral areas have four or six rows of tubercles abreast. The spines are long, slender, and needle-shaped; they measure four fifths of an inch in length, have a small conical head, a prominent, narrow, milled ring, and a long, slender stem, which tapers gradually from the ring to the point; their surface is finely marked with longitudinal lines.

Affinities and differences.—This species might be mistaken for *Hemipedina Bowerbankii*, but its test is smaller, and its spines are longer and more slender; the head is more conical, the milled ring is narrower and more prominent; I believe it is identical with Mr. Broderip's species.

Locality and Stratigraphical position.—This specimen has been kindly communicated, together with the following species, by my friend Mr. Bowerbank, who collected it from the Lower Lias at Lyme Regis, from one of the layers of marl which inter-stratifies the beds of limestone.

HEMIPEDINA BOWERBANKII, *Wright*. Pl. IX, fig. 2 *a*, *b*, *c*.

HEMIPEDINA BOWERBANKII. Wright, *Annals and Magazine of Natural History*, 2d series, vol. xvi, p. 96.

Ambulacral areas narrow, with two rows of marginal tubercles, rather smaller than those of the inter-ambulacra, one tubercle on every third or alternate plate; inter-ambulacral areas wide, with six rows of tubercles abreast, each surrounded by a delicate areolar circle; spines long and needle-shaped, deeply sculptured with longitudinal lines. Form unknown, as the test is crushed.

Dimensions.—One inch and one twentieth of an inch in diameter; height unknown.

Description.—The only specimen of this species I have seen is the one collected by my friend Mr. Bowerbank, and figured in Pl. IX, fig. 2. The test is unfortunately much crushed, but a sufficient number of plates are preserved to enable me to make a short description of this beautiful Liassic form.

The ambulacral areas are more than one third the width of the inter-ambulacral; they are composed of narrow, hexagonal plates (Pl. IX, fig. 2 *b*); on every third plate a small tubercle is developed, about midway between the zones and the central suture, but nearer to the latter; on the intervening plates there are only two or three small granules on each; the poriferous zones are narrow and straight, the pairs of pores having an oblique direction upwards and inwards; there are four ambulacral plates opposite each inter-ambulacral one; the number of plates in a column cannot be ascertained, as all of them are more or less incomplete.

The inter-ambulacral areas are more than double the width of the ambulacral; they are composed of narrow, pentagonal plates (fig. 2 *b*); on the centre of each is a primary tubercle, and on each side a smaller secondary tubercle; these three tubercles are disposed nearly on the same line, and two smaller tubercles are developed near the lower angles of the plate; the central tubercle is surrounded by an areola, and an incomplete circle of small, spaced-out granules encircles it; granules of the same size form circles around the secondary tubercles, but in them the areola is small or altogether absent.

At the equator each inter-ambulacra is provided therefore with six rows of tubercles, which are arranged nearly all abreast, and four rows of smaller tubercles placed near the lower angles of the plates; but in the upper part of the area, the rows of secondary tubercles dwindle into granules, and finally disappear (fig. 2 *a*); there are four pairs of pores opposite each large inter-ambulacral plate (fig. 2 *b*).

The apical disc is not preserved; and as the base is imbedded in the clay, the structure of the under surface is unknown.

The spines, many of which are preserved *in situ*, are long and needle-shaped; they are shorter and stouter than those of *Hemipedina Bechei* (fig. 1 *b*), although the diameter of the test of *H. Bowerbankii* greatly exceeds that of *H. Bechei*; the spines of *H. Bowerbankii* are three quarters of an inch in length; the head does not taper much towards the acetabulum (fig. 2 *c*); the milled ring is thick, but not so prominent as in *H. Bechei*; the stem likewise is thicker at the base, and tapers regularly to the point; the surface is deeply sculptured with fine longitudinal lines.

Affinities and differences.—This species very much resembles *Hemipedina Bechei*, but the imperfect condition of the test of that species renders a comparison of this part of the body with that of *H. Bowerbankii* impossible; the spines, however, of the two species, which are drawn side by side on the plate (figs. 1 *b*, 2 *c*), show that these two nearly allied forms from the same bed are, however, specifically distinct, the spine of *H. Bechei* being longer and more slender than that of *H. Bowerbankii*, although the test to which it was attached is smaller; the milled ring in *H. Bechei* is narrower and more prominent, and the head more conical, than the homologous parts in *H. Bowerbankii*. It resembles *Diadema seriale*, Leymerie (Pl. IX, fig. 3 *a*, *b*), from the Inferior Lias of France, which I have copied * for the purpose of comparison, and likewise to show the probable form of our Lias specimen. In this very rare urchin, the primary tubercles are larger (fig. 3 *b*), and there are only two, nearly of the same size, abreast on each plate; the scrobicular circles are more complete (fig. 3 *b*), and the granulations fewer but more numerous; the pores are much closer set together in the zones, there being twelve pairs opposite each inter-ambulacral plate.

Locality and Stratigraphical position.—*Hemipedina Bowerbankii* was collected from the marly beds of the Lower Lias, at Lyme Regis, by Mr. Bowerbank, to whose magnificent collection it belongs. I have not ascertained the precise Ammonital zone in which this urchin was found. I have great pleasure in dedicating this species to our amiable, excellent, and indefatigable Secretary, to whose great and continued exertions, through a series of years, the Palæontographical Society owes much of its present success.

HEMIPEDINA JARDINII, *Wright*. Pl. IX, fig. 4 *a*, *b*, *c*, *d*, *e*, *f*.

HEMIPEDINA JARDINII. Wright, Annals and Magazine of Natural History, 2d series, vol. xvi, p. 96.

Test small, much depressed; ambulacral areas wide, with two rows of marginal

* 'Mémoires de la Société Géologique de France,' t. ii, p. 330, pl. 24, fig. 1, 1839.

tubercles, which extend from the peristome to the disc; inter-ambulacral areas with two rows of tubercles set near the poriferous zones, eleven to twelve in each row; a delicate circle of small granules around each, and a naked space in the centre of the miliary zone; mouth opening small, peristome decagonal; base exhibiting very regular radii of tubercular rows.

Dimensions.—Height, one fifth of an inch; transverse diameter, half an inch.

Description.—The test of this beautiful little Diadem is small, circular, and depressed on the upper and under surfaces; the ambulacral areas are narrow, with two rows of small tubercles (fig. 4 *d*) set alternately on the sides of the area, close to the poriferous zones (fig. 4 *g*); a line of granules occupies the course of the central suture, and additional granules fill up the space between that line and the pores (fig. 4 *g*); there are from twelve to fourteen tubercles in each row; about one third the size of those of the inter-ambulacra, but much smaller in proportion in the upper part of the area (fig. 4 *d*); the zones are narrow and straight throughout; the septa forming slight papillæ on their surface; the pores are very small, and there are four pairs of holes opposite each of the large plates.

The inter-ambulacral areas are nearly three times the width of the ambulacral; they have two rows of primary tubercles, about ten or eleven in each row; the tubercles occupy the centre of the plates (fig. 4 *g*); the boss is prominent, the tubercle small, and the areola not well defined; on each side of the tubercle there are two rows of granules, the inner of which forms a circle around the boss (fig. 4 *g*); the miliary zone is wide (fig. 4 *f*), and filled with the granules just described; interspersed among them are several which pass into the condition of minute tubercles, being raised on miniature bosses, and having their surface perforated. On the upper part of the area the granules disappear from the centre, leaving a portion of the plates naked (fig. 4 *d*); as the granules are disposed with much regularity, the test of this species has a highly ornamented appearance (fig. 4 *d, e, f*).

The base is concave, and the mouth opening, which is less than half the diameter of the shell, is situated in a depression; the peristome is decagonal, the ambulacral being larger than the inter-ambulacral lobes: as the primary tubercles of the inter-ambulacra are set close together at the base, they form prominent tuberculated radii (fig. 4 *e*) in this region.

The discal opening is small, but the plates are absent.

Affinities and differences.—This species resembles *H. Etheridgii*, but it is a smaller and more depressed form; the tubercles of the ambulacra are larger in size and fewer in number; and those of the inter-ambulacra want the well-defined areolas around them, seen in the primary tubercles of *H. Etheridgii* (fig. 5 *g*). The discal opening is likewise a much smaller aperture in *H. Jardinii* than in *H. Etheridgii*.

Locality and Stratigraphical position.—This beautiful little Diadem has been found in the Marlstone of Bredon, Alderton, and Dumbleton Hills, Gloucestershire, and in the same rock at Ilminster, Somersetshire. It is everywhere a very rare form. I dedicate this species to my friend Sir William Jardine, Bart., of Jardine Hall, Dumfriesshire, author of a magnificent work on the 'Ichnology of Annandale,' and other valuable treatises on different branches of Natural History.

HEMIPEDINA ETHERIDGII, *Wright*. Pl. IX, fig. 5 *a, b, c, d, e, f, g*.

PEDINA ETHERIDGII.

Wright, Annals and Magazine of Natural History, 2d series, vol. xiii, p. 315, pl. 11, fig. 5 *a—c*.

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Morris, British Fossils, 2d edition. Additional species.

HYPODIADEMA ETHERIDGII. Desor, Synopsis des Échinides Fossiles, p. 61.

Test circular, depressed; ambulacral areas with from six to eight small perforate tubercles at their base, and a double row of small granules on their upper surface; the inter-ambulacral areas with primary tubercles only, the areolas of which are surrounded by regular circles of granules; pedal pores not numerous, arranged in nearly a single file, with a slight elevation between the two pores of each pair; apical disc large; ovarian plates leaf-like; mouth opening small.

Dimensions.—Height, one quarter of an inch; transverse diameter, half an inch.

Description.—This pretty little urchin has a circular outline in the young state, which in larger specimens inclines towards a pentagonal form; the base is flattened, and the upper surface is much depressed (fig. 5 *c*). The ambulacral areas are straight and narrow (fig. 5 *d, e, f*); they have from six to eight small perforated tubercles at their base (fig. 5 *e*), and a double row of from twelve to fourteen minute, imperforate granules in each row on their upper surface (fig. 5 *d*), which, in form and size, resemble those covering the other parts of the test (fig. 5 *g*); between the pedal pores of each pair is a small elevation (fig. 5 *g*); these collectively form a prominent moniliform line, which extends from the margin of the disc to the mouth opening; the pores are unigeminal, and disposed in nearly a single file throughout (fig. 5 *g*). The inter-ambulacral areas are about twice the width of the ambulacral; the rows of primary tubercles occupying the centre of the plates have seven or eight tubercles in each row; they are small in size, and rendered prominent from being raised upon uncrenulated mammillary eminences, the bases of which are sharply defined, and surrounded by complete circles of small scrobicular granules (fig. 5 *g*); the regular disposition of these granulations gives an air of decoration to this beautiful little species, and the entire absence of secondary tubercles from the areas renders the ornamentation even more complete (fig. 5 *d, e, f*). The apical disc

is large (fig. 5 *d*); the ovarian plates are widely rhomboidal (fig. 5 *d*); the oculars are small and heart-shaped; and the surface of both is covered with minute granules, nearly as large as those which adorn other parts of the test. The madreporiform tubercle makes a distinct elevation on the surface of the right antero-lateral plate (fig. 5 *d*); the anal aperture is transversely oblong; the base is flat, the mouth opening small, and the peristome divided into ten nearly equal-sized lobes; the spines are unknown.

Affinities and differences.—In its general outline, depressed upper surface, and unigeminal pores, this little urchin resembles a *Pseudodiadema*. From that group, however, it is distinguished by the rudimentary condition of the ambulacral tubercles, and the absence of crenulations from the summits of the bosses. It is distinguished from *Hemipedita Bakeri* by having small primary tubercles set more closely together, and in having a greater number in each row. From *Pedita rotata* it is known by having unigeminal pores, the upper surface more depressed, the pedal pores separated by a moniliform line of granules, and in the absence of secondary tubercles. At a first glance, it has a strong resemblance to *Pseudodiadema Moorei*, but an examination with the lens at once discloses the points of difference, which are these: the ambulacral areas in *Hemipedita Etheridgii* have imperforate granules on their upper parts, whilst in *Pseudodiadema Moorei* they are perforated tubercles; the moniliform line between the pedal pores in *Hemipedita Etheridgii* is absent in *Pseudodiadema Moorei*; the mouth opening is likewise much smaller in *Hemipedita Etheridgii*.

Locality and Stratigraphical position.—This species has been found in the Upper Lias of Gloucestershire, and in the Upper Lias near Ilminster, Somersetshire, associated with *Ammonites (Walcotii) bifrons*, Brug.; *Ammonites serpentinus*, Schloth.; *Ammonites annulatus*, Sow.; and other Upper Liassic forms of Mollusca and Radiata. It is a very rare urchin, and is seldom found in a good state of preservation. Professor Deslongchamps has collected the same species in “le Lias supérieur de May et Fontaine—Etopefour, Calvados.” I dedicate this species to my friend Robert Etheridge, Esq., F.R.S.E., of the Bristol Museum, who has kindly assisted me in comparing my specimens with the fine series of Echinoderms under his care, and who has likewise otherwise aided me in the most friendly manner, in working out the subjects of this Monograph.

B. *Species from the Inferior Oolite.*

HEMIPEDINA BAKERI, *Wright*. Pl. X, fig. 1 *a, b, c, d, e, f*.

PEDINA BAKERI. Wright, *Annals and Magazine of Natural History*, 2d series, vol. xiii, p. 312, pl. 11, fig. 4.

HEMIDIADEMA BAKERI. Desor, *Synopsis des Échinides Fossiles*, p. 58.

Test circular, depressed; ambulacral areas narrow, with one row of small tubercles, disposed in a slightly zigzag line, down the centre of the areas; inter-ambulacral areas broad, with two rows of primary tubercles in the centre of the plates, raised on prominent bosses; margins of the areolas surrounded by circles of small granules; no secondary tubercles.

Dimensions.—Height, seven twentieths of an inch; transverse diameter, three fourths of an inch.

Description.—This rare urchin has the test circular and depressed (fig. 1 *b, c*); the ambulacral areas are narrow, about one third the width of the inter-ambulacral; the usual double row of tubercles in this region is reduced to one row, the tubercles of which are disposed alternately on the right and left sides of the areas, thereby forming a single zigzag line down the centre thereof (fig. 1 *b, c, d*); the tubercles at the equator, and on the upper surface, are small (fig. 1 *b*), but there are two or three of a larger size at the base of the areas (fig. 1 *d*); a few granules form imperfect scrobicular crescents round the narrow areolas (fig. 1 *d*). The inter-ambulacral areas are nearly three times the width of the ambulacral (fig. 1 *b*); they are adorned with five pairs of primary tubercles, nearly of a uniform size throughout (fig. 1 *b, c, d*), raised on prominent bosses, the summits of which are smooth, ring-like, and without crenulations (fig. 1 *d, e*); circles of small granules bound the areolar spaces; there are no secondary tubercles, nor any other sculpture upon the inter-tubercular surface of the plates, so that down the centre of the areas there is a smooth valley between the primary tubercles (fig. 1 *d, c, b*). The apical disc is well preserved (fig. 1 *b, f*); the ovarian plates are of moderate size, and have an irregular, heptagonal form; they are covered with a few granules, scattered irregularly over their surface; the ocular plates are rhomboidal, and have large eye-holes perforated near the centre (fig. 1 *f*).

The base is flat (fig. 1 *c*), and the mouth opening small (fig. 1 *a*); the peristome is divided into ten lobes by shallow notches.

Affinities and differences.—This species differs so much from all its congeners, that it cannot be mistaken for either of them. Its diagnostic characters consist in the size and number of the primary tubercles (fig. 1 *b*), the absence of secondary tubercles, the naked valley in the centre of the miliary zone (fig. 1 *c, d*), the narrowness of the ambulacra, with the single row of tubercles therein (fig. 1 *d*).

Locality and Stratigraphical position.—I have collected only one specimen of this singular form in the Pea Grit at Crickley Hill, and have seen fragments only on the surface of other fossils, as one or two plates suffice for the determination of this species. I dedicate this fine urchin to my friend T. Barwick L. Baker, Esq., of Hardwicke Court, Gloucestershire, the President of the Cotteswold Naturalists' Club.

HEMIPEDINA PERFORATA, *Wright*. Pl. X, fig. 2 *a, b, c, d, e, f, g*.

GONIOPYGUS PERFORATUS. *Wright*, *Annals and Magazine of Natural History*, 2d series, vol. viii, p. 267, pl. 13, fig. 5 *a, b*.

HEMIPEDINA PERFORATA. *Wright*, *Annals and Magazine of Natural History*, 2d series, vol. xvi, p. 98.

Test small, circular, depressed; ambulacral areas with two rows of small tubercles, which extend from the peristome to the disc; inter-ambulacral areas with two rows of tubercles, seven to eight in each row, and three or four secondary tubercles near the base; mouth opening large; peristome decagonal, divided into deep, nearly equal-sized lobes; apical disc large, plates much developed.

Dimensions.—Height, one quarter of an inch; transverse diameter, three quarters of an inch.

Description.—This little Diadem was first figured and described as *Goniopygus perforatus*, at a time when I was ignorant of the true organic characters of the group to which it belongs. “I have placed this urchin,” I observed, “provisionally in the genus *Goniopygus*, as it comes nearer to the character of that form than any other. The absence of crenulations on the mammæ, the nearly uniform size of the tubercles, the distinctness with which they stand out from the test, and a fragment of the angular apical disc *in situ*, seem to justify the supposition of its being a *Goniopygus*; but the perforation of the tubercles makes the exception, and suggests the query whether the absence of perforations is a generic or only a sectional character.”* At the time this passage was written I had only found three imperfect specimens of this species, and the search after more perfect urchins of the same natural group led to the discovery of several new congeneric forms, and finally to the establishment of the genus *Hemipedinina* for their reception.

The ambulacral areas are narrow, and carry two rows of small tubercles, which, from the peristome to the equator, are regularly developed (fig. 2 *c*); but above the equator they rapidly diminish in size, and dwindle into small granules in the upper part of the area (fig. 2 *a, b, g*).

The poriferous zones are narrow and straight, the septa moderately thick, and at the base of the area the pores fall into triple, oblique pairs (fig. 2 *f*), but in the upper part they are strictly unigeminal.

The inter-ambulacral areas are twice and a half the width of the ambulacral, and furnished with two rows of tubercles, from seven to eight in each row (fig. 2 *b, c*); the bosses are prominent, and surrounded by a narrow areola (fig. 2 *g*, the letter omitted);

* ‘*Annals and Magazine of Natural History*,’ 2d series, vol. viii, p. 267.

the spinigerous tubercles are small, and not deeply perforated; they stand out, however, in a well-defined manner, from the surface of the test, and are very uniform in size throughout; a complete circle of granules surrounds each areola (fig. 2 *g*), and one row of granules separates the areolas from the zones; the miliary zone is wide (fig. 2 *b*), and filled with four rows of round granules, which are very uniform in size, and closely crowded together (fig. 2 *g*), thus imparting a granular aspect to the surface; the upper part of the centro-sutural line is naked for the space of the two uppermost plates (fig. 2 *b*).

The apical disc is large (fig. 2 *b*); the five genital plates have a heptagonal form, and are nearly all of the same size; they are perforated at some distance from the apex, and in the centre of each plate is a cluster of small granules (fig. 2 *e*); the ocular plates are pentagonal, and large in proportion to the size of the urchin; they have granules on their surface, and the eye-hole is perforated at some distance from the margin; the anal opening is round and central, and the madreporiform body is very small (fig. 2 *e*).

The base is concave, and the mouth opening, which is situated in a depression, is one half the diameter of the test; the peristome is decagonal, and divided into nearly equal-sized lobes.

Affinities and differences.—This species is nearly allied to *H. Jardinii* and *H. Etheridgii*, but is distinguished from both by the structure of the ambulacra, in which the marginal tubercles are large and well developed at the base of the area (fig. 2 *f*), but suddenly diminished in size, or rather reduced to granules, in the upper part of the same (fig. 2 *g*); whereas in these other two allied forms they are very regularly developed throughout the area (Pl. IX, fig. 4 *d*, and fig. 5 *d*, which compare with Pl. X, fig. 2 *b*, *g*).

Locality and Stratigraphical position.—I collected this species from that remarkable rock, the Pea Grit, at Crickley Hill. The species must have been tolerably abundant, although very few specimens are well preserved. Out of a considerable number I have only obtained two or three in which the structure of the test can be satisfactorily made out.

HEMIPEDINA TETRAGRAMMA, *Wright*. Pl. X, fig. 3 *a*, *b*, *c*, *d*.

HEMIPEDINA TETRAGRAMMA. Wright, Annals and Magazine of Natural History, 2d series, vol. xvi, p. 98.

Test circular and depressed; ambulacral areas narrow, with two rows of small, nearly equal-sized tubercles on the margin of the area, extending from the peristome to the disc; inter-ambulacral areas with two rows of primary tubercles, about fourteen in each row, and two rows of secondary tubercles, ten in each row, extending from the peristome nearly

to the upper surface; mouth opening small, situated in a depression; peristome decagonal and unequally lobed.

Dimensions.—Height, two fifths of an inch; transverse diameter, nine tenths of an inch.

Description.—This beautiful Hemipedina is a very rare form, having only found one specimen of the species during the many years I have collected from the locality where it was discovered.

The tubercles of the ambulacra are nearly as large as those of the inter-ambulacra, which imparts a very regular appearance to the test (fig. 3 *b*, *c*).

The ambulacral areas are narrow, about one third the width of the inter-ambulacral; on the margins are two rows of tubercles, about twenty in each row; they are very uniform in size, and arranged in a straight line throughout the area (fig. 3 *b*, *c*, *d*); the bosses abut against the poriferous zones, but they are separated from each other by a delicate, double line of granules, which extends on each side of the central suture (fig. 3 *d*), every third granule between the tubercles being larger. The poriferous zones are narrow, and slightly undulated, in consequence of the ambulacral tubercles being placed so close to the avenues, without the intervention of any granular space between to prevent the encroachment of the tubercles on them (fig. 3 *b*, *c*, *d*).

The inter-ambulacral areas are four times as wide as the ambulacral; at the equator, each of the large plates of these areas has one central primary tubercle, and at its centrosutural side, one secondary tubercle, and between the central tubercle and the zones two rows of granules (fig. 3 *d*); from the peristome to the equator there are therefore four rows of tubercles (fig. 4 *d*, *c*), but as the secondary tubercles diminish in size above the equator, and disappear on the upper surface, there are only two rows of tubercles near the circumference of the apical disc (fig. 3 *b*); the bosses are not very prominent; the tubercles small, the minute granules forming circles around the rudimentary areolas (fig. 3 *d*); there are fourteen primary tubercles and ten secondary tubercles in each row, and from four to five pairs of pores in each of the large inter-ambulacral plates.

The base is very concave, and the small mouth opening lies in rather a deep depression; unfortunately it is filled with a hard mass of pisolite, which cannot be dislodged without risk to the shell (fig. 3 *c*).

The discal opening is small, but all the plates of the disc are absent.

Affinities and differences.—The regularity of the ambulacral tubercles, and the nearly uniform size they have in both areas, distinguishes this species from its congeners; the fact that the inter-ambulacra have four tubercles abreast at the equator, forms a good diagnostic character, and serves to distinguish it from other allied species found with it in

the same rock. *Hemipedina perforata* and *Hemipedina Waterhousei* having two rows, and *Hemipedina Bonei* six rows of tubercles in this region.

Locality and Stratigraphical position.—The only specimen I have seen of this species I collected from the Pea Grit at Crickley Hill, along with *Hemipedina perforata*, *Acrosalenia Lycettii*, *Polycyphus Deslongchampsii*, and *Pseudodiadema depressum*.

HEMIPEDINA WATERHOUSEI, *Wright*. Pl. X, fig. 4 *a, b, c, d, e*.

HEMIPEDINA WATERHOUSEI. *Wright*, Annals and Magazine of Natural History, 2d series, vol. xvi, p. 98.

Test small, pentagonal, rather inflated at the sides; ambulacral areas with two rows of small tubercles extending from the peristome to the disc; inter-ambulacral areas with two rows of tubercles, eight in a row; scrobicular circles neatly defined; mouth opening small; apical disc narrow and prominent.

Dimensions.—Height, seven twentieths of an inch; transverse diameter, half an inch.

Description.—This is a small, pentagonal, inflated species, having the ambulacral areas with two rows of tubercles, nearly as large as those of the inter-ambulacral; there are from twelve to thirteen tubercles in each row, which are placed further apart than those of *H. tetragramma*, each tubercle being surrounded by small, scattered granules (fig. 4 *c, e*); the poriferous zones are narrow and straight (fig. 4 *e*), and the septa are slightly elevated on the surface; there are four pairs of pores opposite each of the large plates.

The inter-ambulacral areas are not quite twice the width of the ambulacral; they are occupied by two rows of primary tubercles, about nine in each row, which have slightly elevated bosses, surmounted by small tubercles; the base of the boss is closely encircled by small granules (fig. 4 *e*), which form complete scrobicular circles around them; each plate has one row of granules between the tubercles and the zones, and two rows of granules between the tubercles and centro-sutural line (fig. 4 *e*).

The apical disc is well preserved in both my specimens (fig. 4 *b, d*); the genital plates have a heptagonal form, the largest side being placed towards the anal opening; they are perforated at a short distance from the apex, and two or three granules are developed on the surface; the right antero-lateral plate is a little larger than the others, and supports, as usual, a small, spongy, madreporiform body; the ocular plates are small and pentagonal; the holes are perforated near the centre of each; the disc forms a slight, ring-like prominence at the vertex of the test, and the anal opening is circular.

The base is flattened, but the mouth opening is unfortunately concealed in the only two specimens I have found.

Affinities and differences.—I regarded this urchin, at first sight, as a young form of *H. tetragramma*, but the spaced-out arrangement of the ambulacral tubercles, the inflation of the sides of the test, and the presence of only two rows of tubercles in the inter-ambulacra, show that it is quite distinct from that species. It is so entirely different from *H. perforatus* and *H. Bakeri*, that it cannot be mistaken for either of them.

Locality and Stratigraphical position.—I collected this urchin in the Pea Grit at Crickley Hill, with the former. It must be rare, as I only know two examples of the species, which I dedicate to my friend G. R. Waterhouse, Esq., F.Z.S., of the British Museum, well known by his valuable contributions to zoological literature, and by the kindness and urbanity of his manner to all who seek information in that department of the great national collection committed to his care.

PLATE I.

Cidaris from the Lias.

Fig.

- 1 *a.* CIDARIS EDWARDSII, *Wright*, p. 26. Natural size, and restored to its globular form.
b. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified three diameters.
c. A view in profile of one of the primary tubercles, magnified three times.
d. A secondary spine, from an ambulacral area.
e. The same, magnified five times.
f. One of the primary spines, magnified three times.
g. Lateral view of a jaw and tooth, magnified one and a half times. This specimen shows a portion of the buccal membrane, with the spines which clothed the same.

Cidaris from the Inferior Oolite.

- 2 *a.* CIDARIS BOUCHARDII, *Wright*, p. 36. Shell natural size, showing the base.
b. Ditto, a side view of the same.
c. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified four diameters.
- 3 *a.* CIDARIS WRIGHTII, *Desor*, p. 39. Test the natural size, showing the upper surface.
b. Test the natural size, showing a lateral view.
c. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified four times.
d. A primary spine, supposed to belong to *C. Wrightii*.
e. Another spine, referred to the same species.
f. A portion of the same, magnified four diameters.
- 4 *a.* CIDARIS FOWLERI, *Wright*, p. 32. Natural size, showing the base of the test, with the jaws *in situ*.
b. Lateral view of the same, showing the projection of the jaws.
c. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified three diameters.
d. Portion of a spine attached to the test, this specimen belongs to the Museum of Geology, Jermyn Street.
- 5 *a.* DIPLOCIDARIS WRIGHTII, *Desor*, p. 58. Fragment of a spine.
b. The same, magnified two and a half diameters.
c. nov. sp.

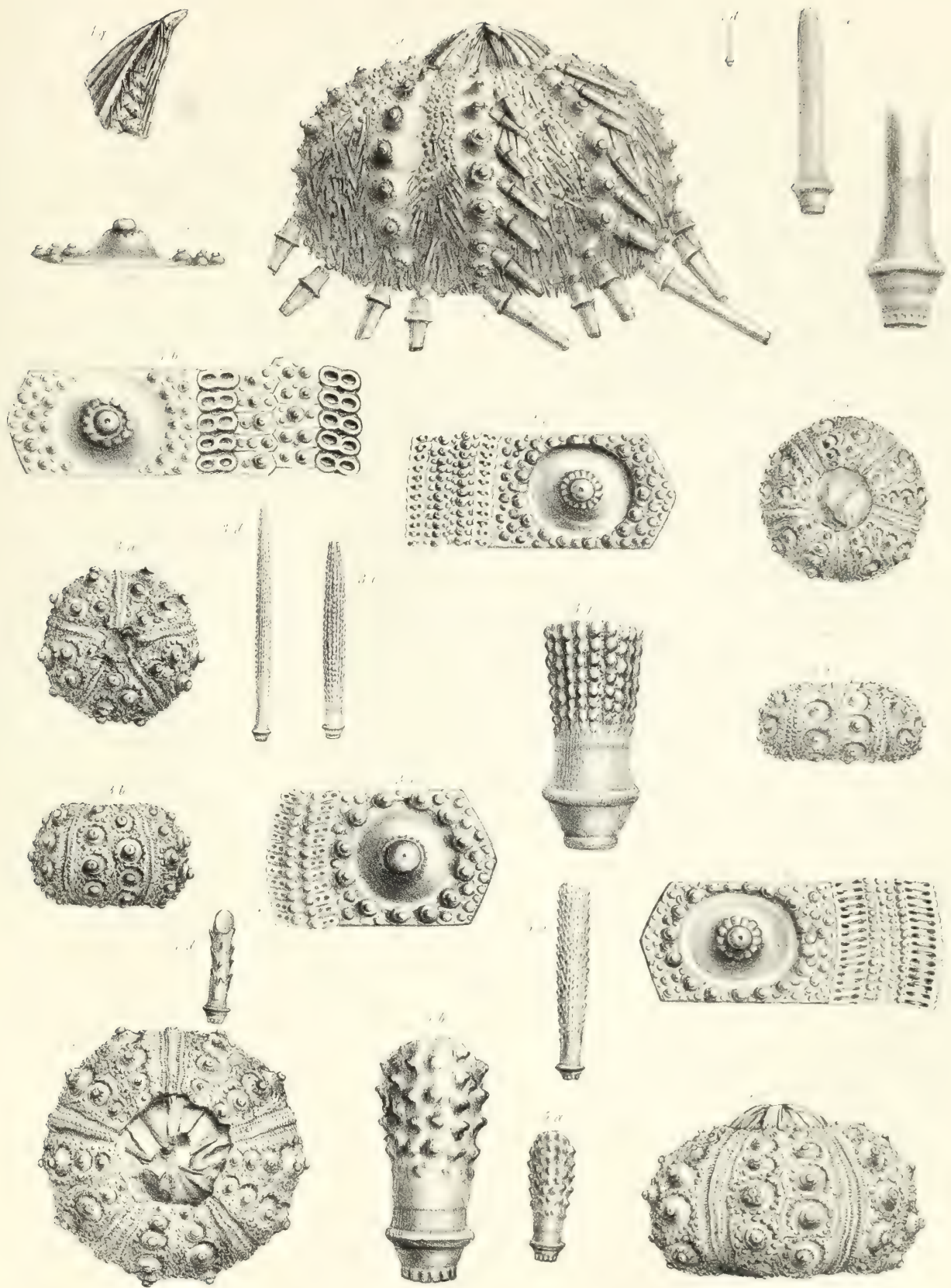


PLATE II.

Cidaris from the Coralline Oolite.

Fig.

- 1 *a.* CIDARIS SMITHII, *Wright*, p. 50. Under surface of the test, natural size, showing the jaws *in situ*.
- b.* Lateral view of another specimen, natural size.
- c.* One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones, magnified two diameters.
- d.* Inter-ambulacral plate, with its primary tubercle seen in profile, and magnified two diameters.
- e.* Fragment of a spine attached to the test "*a*," magnified two diameters.
- 2 *a.* CIDARIS FLORIGEMMA, *Phillips*, p. 44. Test with spines attached, on a slab of Coralline Oolite.
- b.* A large test, natural size, showing the base and mouth opening.
- c.* Lateral view of the same test, natural size.
- d.* Primary spines of *Cidaris florigemma*, natural size.
- e.* Head, neck, and acetabulum of the same, magnified two diameters.
- f.* Small, spatulate, secondary spines, magnified three and a half times.
- g.* One inter-ambulacral plate, and a portion of an ambulacral area with the poriferous zones; magnified two diameters.

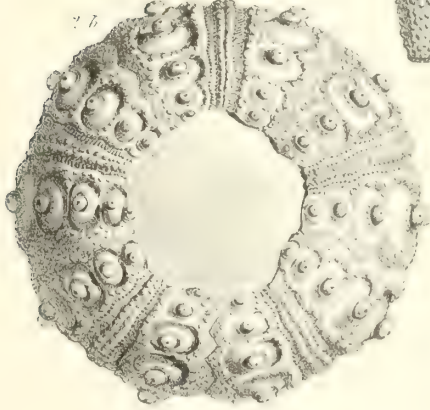
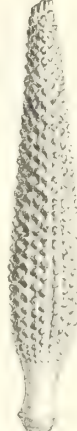
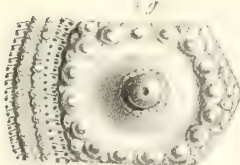
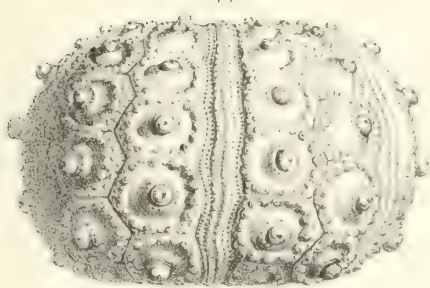
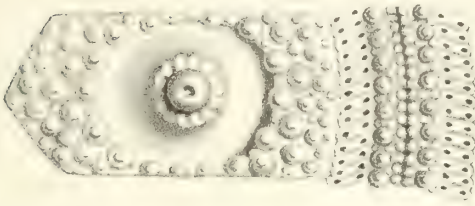
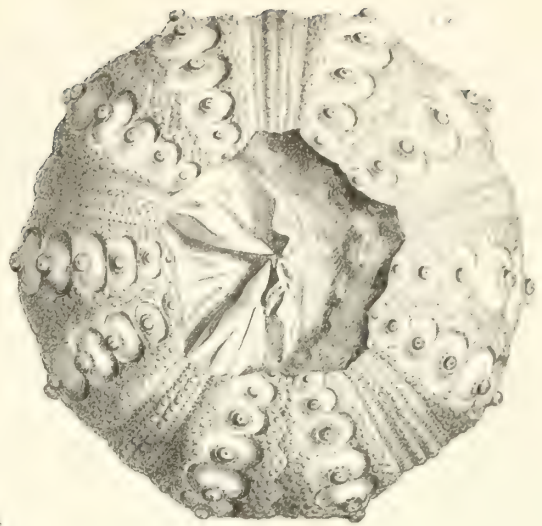
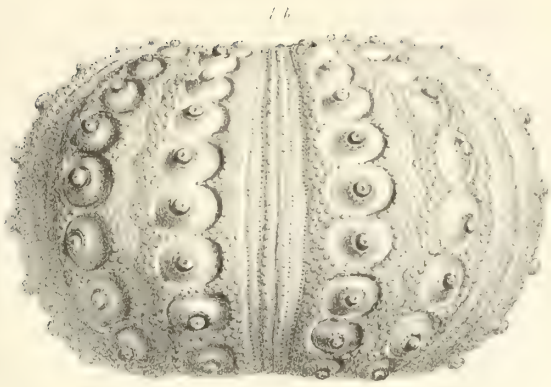


PLATE III.

Hemicidaris from the Inferior Oolite.

Fig.

- 1 *a.* HEMICIDARIS PUSTULOSA, *Agassiz*, p. 73. Upper surface of the test, natural size.
b. Lateral view of the same, natural size.
c. Two inter-ambulacral plates, and a portion of an ambulacral area, showing the two upper pairs of semi-tubercles and poriferous zones; magnified three diameters.
d. A primary tubercle seen in profile, magnified two diameters.
e. Apical disc, magnified two diameters.
- 2 *a.* HEMICIDARIS GRANULOSA, *Wright*, p. 71. Upper surface of the test of a small urchin, natural size.
b. Base of a large specimen, showing the mouth opening.
c. Lateral view of the same test, both the natural size.
d. One inter-ambulacral plate, and a portion of an ambulacral area with the poriferous zones; magnified three diameters.
e. Inter-ambulacral plate and tubercle seen in profile, magnified three times.

Hemicidaris from the Stonesfield Slate and Great Oolite.

- 3 *a.* HEMICIDARIS STOKESII, *Wright*, p. 75. Test natural size, imbedded in Stonesfield Slate.
b. One inter-ambulacral plate, and a portion of an ambulacral area with the poriferous zones; magnified three diameters.
c. Apical disc, magnified two diameters.
- 4 *a.* HEMICIDARIS ICAUNENSIS, *Cotteau*, p. 90. Lateral view of the test, an interior mould.
b. Upper surface of the same, both the natural size.
- 5 *a.* HEMICIDARIS MINOR, *Agassiz*, p. 80. Test natural size, showing a lateral view.
b. Upper surface, magnified two diameters.
c. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified three diameters.
d. Inter-ambulacral plate and tubercle, seen in profile, and magnified three diameters.
- 6 *a.* HEMICIDARIS LUCIENSIS, *d'Orb.*, p. 78. Test natural size, showing the upper surface.
b. Base of the same, showing the mouth opening, both the natural size.
c. Lateral view of the same test.
d. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified four diameters.
e. Inter-ambulacral plate and tubercle, seen in profile, magnified four times.
f. Apical disc, magnified three diameters.

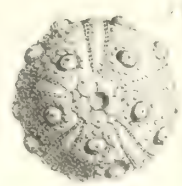
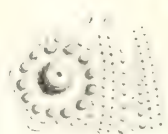
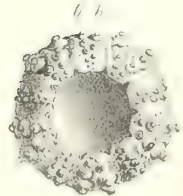
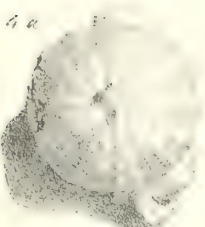
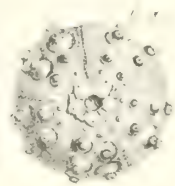
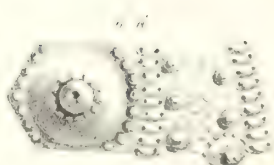
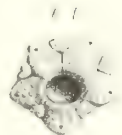
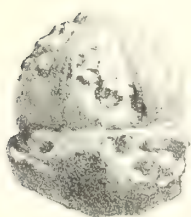
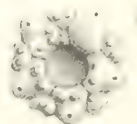
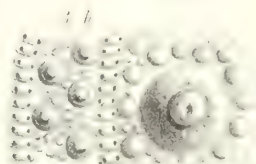
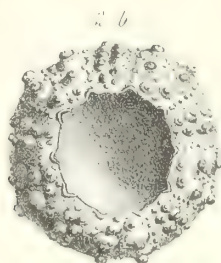
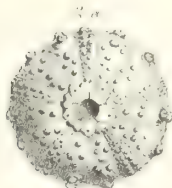
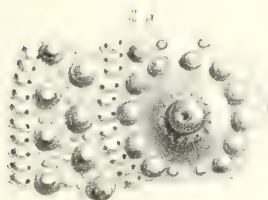
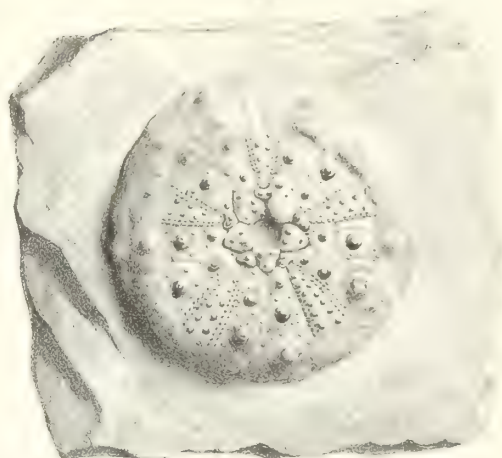
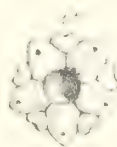
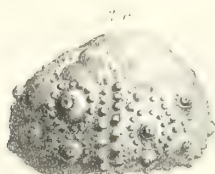
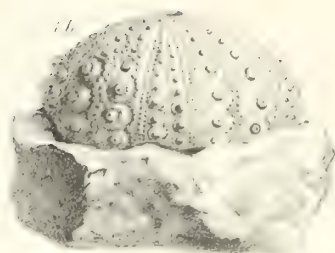
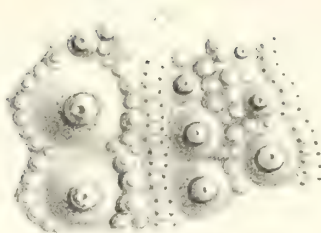
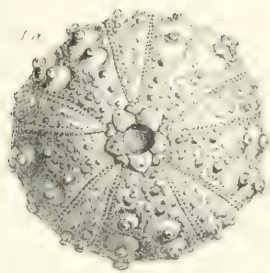


PLATE IV.

Hemicidaris from the Great Oolite.

Fig.

- 1 *a.* HEMICIDARIS BRAVENDERI, *Wright*, p. 84. Upper surface of the test, natural size.
b. Lateral view of the same, both the natural size.
c. One inter-ambulacral plate, and a portion of an ambulacral area, magnified three diameters.
d. An inter-ambulacral plate and tubercle, seen in profile, and magnified three times.
e. Mouth opening and peristome.
f. Apical disc, magnified two diameters.
- 2 *a.* HEMICIDARIS WRIGHTII, *Desor*, p. 88. Upper surface of the test, natural size.
b. Lateral view of the same, natural size.
c. Apical disc, magnified two diameters.
d. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified three times.
e. Base of an ambulacral area, showing the semi-tubercles.
f. An inter-ambulacral plate and tubercle, seen in profile, and magnified twice.
- 3 *a.* HEMICIDARIS SMITHII, *Woodward*. Under surface, showing the base, natural size.
b. Lateral view of the same, natural size.

Hemicidaris from the Purbeck Beds.

- 4 *a.* HEMICIDARIS PURBECKENSIS, *Forbes*, p. 98. Lateral view, showing likewise the upper surface, natural size.
b. Two inter-ambulacral areas, and a portion of an ambulacral area, with the poriferous zones; magnified three times.
c. Primary spine, natural size, showing the head, ring, and neck, magnified four times.
d. A portion of the stem, with the same, magnified.
- 5 *a.* CIDARIS SMITHII, *Wright*, p. 50. Primary spine, with the surface of the stem, magnified three times.
b, c. Head, milled ring, and neck of the same, magnified four times.
d. The acetabulum.
e. A transverse section.
- 6 *a.* CIDARIS ILMINSTERENSIS, *Wright*, p. 31. Inter-ambulacral plate, and a portion of an ambulacral area, natural size.
b. The same, magnified three diameters. The only fragment of the species I know.
- 7 *a.* CIDARIS BRADFORDENSIS, *Wright*, p. 42. Inter-ambulacral plates, natural size.
b. The same, magnified two and a half diameters.
c. Primary spine, found in the same bed of Bradford Clay.
d. The same, magnified three diameters.

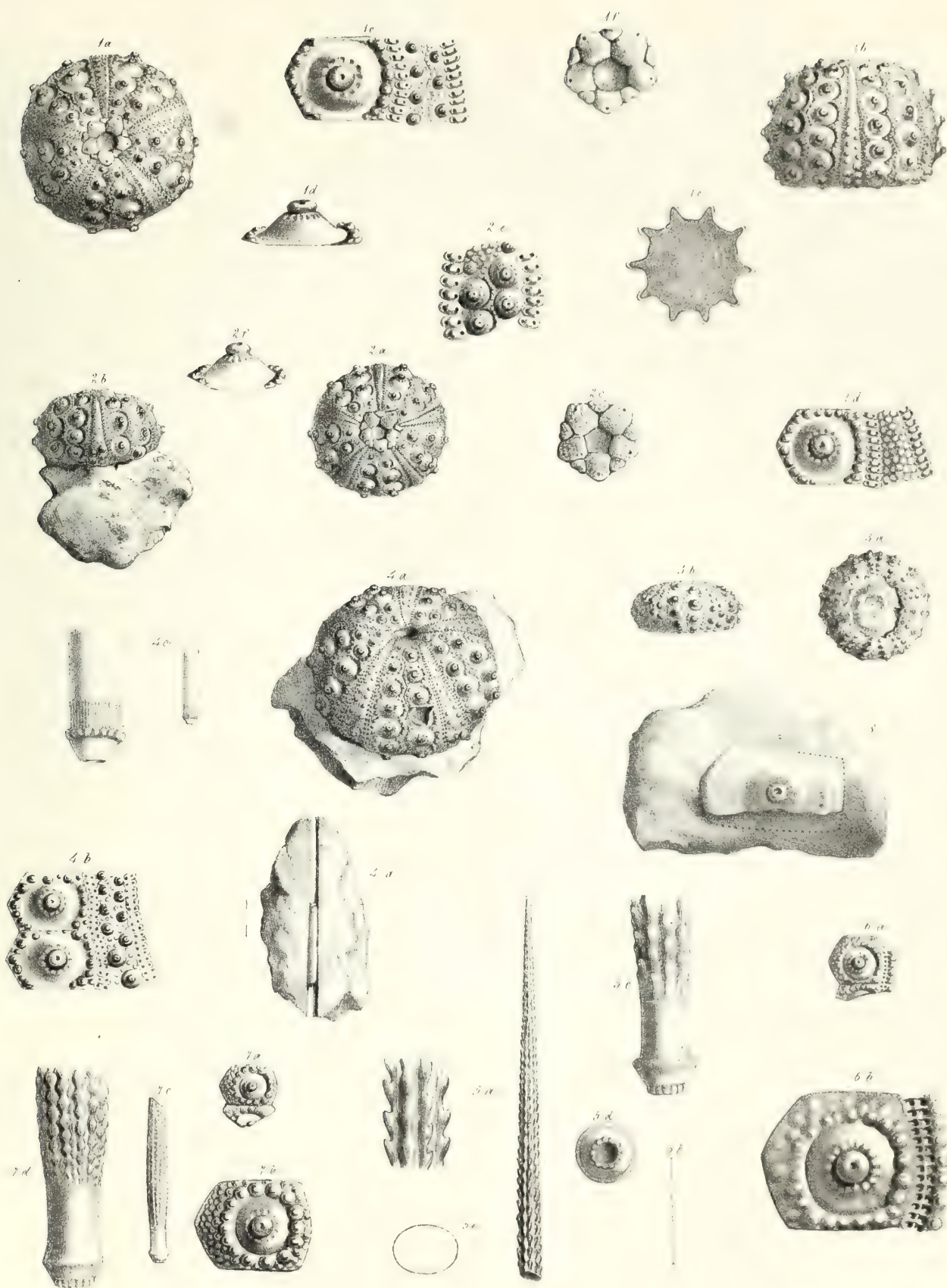


PLATE V.*

Hemicidaris from the Coralline Oolite.

Fig.

- 1 *a.* HEMICIDARIS INTERMEDIA, *Fleming*, p. 92. Upper surface of the test, natural size.
- b.* Under surface, showing the mouth opening, with the jaws and teeth *in situ*.
- c.* Lateral view of the test "*a.*"
- e.* Inter-ambulacral plate and tubercle, seen in profile, and magnified three diameters.
- d.* Two inter-ambulacral plates, and a portion of an ambulacral area, showing the upper pair of semi-tubercles and poriferous zones; magnified three diameters.
- f.* One of the jaws, magnified two diameters.
- g.* Apical disc magnified two diameters.
- h.* Test with spines attached, imbedded in a slab of Coralline Oolite.
- i.* Outline of a conical variety of test in my collection.
- j.* A small spatulate tertiary spine, natural size.
- k.* The same, magnified five times.
- l.* A small secondary spine, natural size.
- m.* The same, magnified five times.
- n.* A primary spine, natural size.
- o.* The same, magnified twice.

Hemicidaris from the Portland Oolite.

- 2 *a.* HEMICIDARIS DAVIDSONI, *Wright*, p. 96. Upper surface of the test, natural size.
- b.* Lateral view of the same, showing the single row of semi-tubercles.
- c.* Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones; magnified three diameters.
- d.* An inter-ambulacral plate and tubercle seen in profile, and magnified twice.
- e.* Mouth opening and peristome, natural size.

* In consequence of the artist having by mistake lettered Plate IV Plate V, and Plate V Plate IV, the reference in the text does not agree with the numbers now unavoidably adopted, as the text and plates were both printed before the error was discovered. This, however, is the less to be regretted, as any confusion which might have arisen will now be prevented when the reason for the discrepancy is explained.

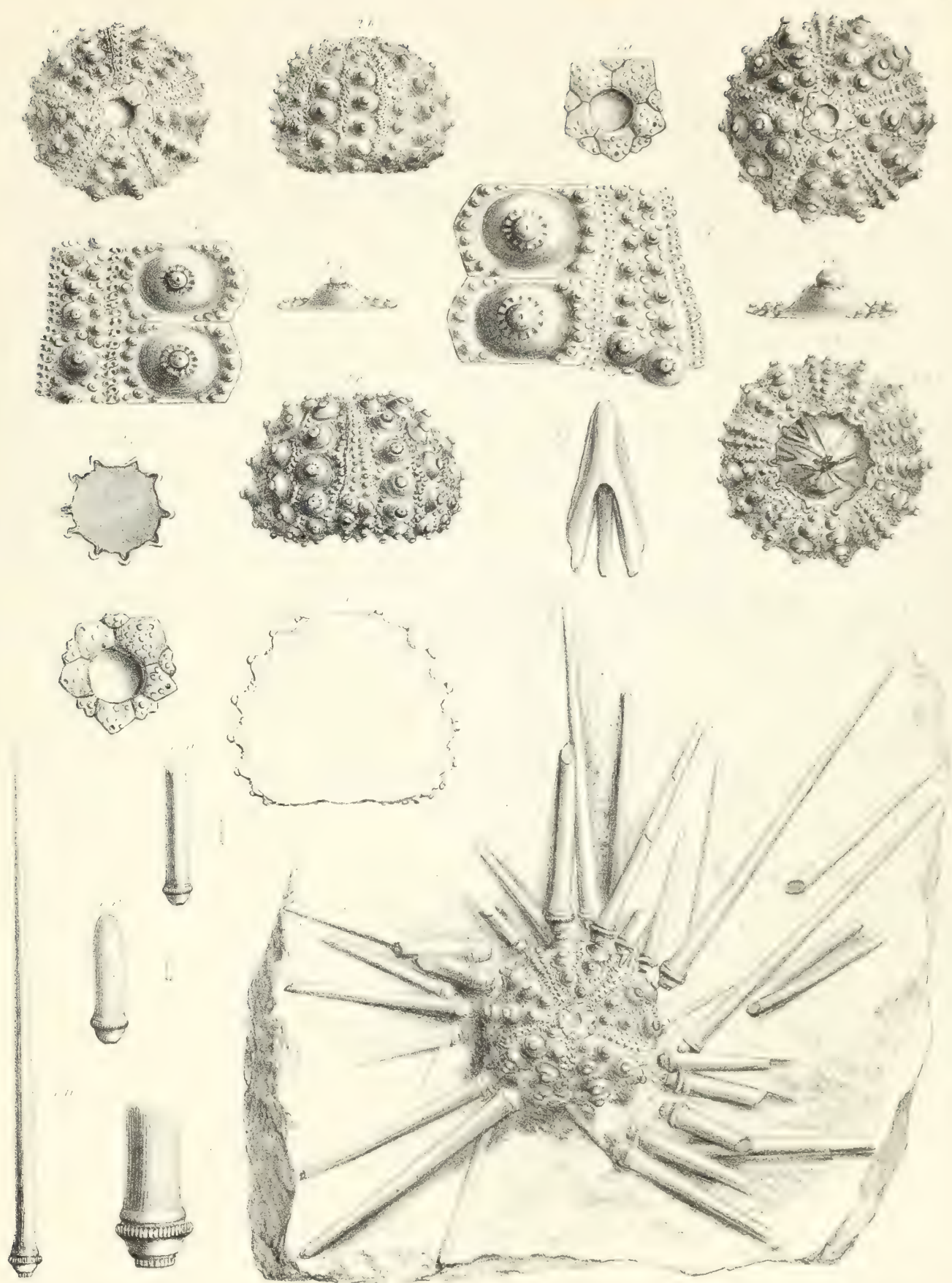


PLATE VI.

Pseudodiademas from the Lias.

Fig.

- 1 *a.* PSEUDODIADEMA MOOREII, *Wright*, p. 110. Test, the natural size.
- b.* Upper surface of the same, magnified two diameters.
- c.* Base and mouth opening of the same, magnified two diameters.
- d.* Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones; magnified four times.

Pseudodiademas from the Inferior Oolite.

- 2 *a.* PSEUDODIADEMA DEPRESSUM, *Agassiz*, p. 112. Upper surface of the test, natural size.
- b.* Base and mouth opening of the same, natural size.
- c.* Lateral view of the same, natural size.
- d.* Two inter-ambulacral plates, a portion of an ambulacral area, with the poriferous zones; magnified three diameters.
- e.* Fragment of a spine, magnified four diameters.
- f.* An entire spine, magnified four diameters.
- g.* Base of an ambulacral area, showing the tubercles and trigeminal arrangement of the pores in this region, magnified three times.
- h.* Inter-ambulacral plate and tubercle, seen in profile, magnified three times.
- i.* A small specimen with its spines attached, lying on a block of Pea Grit.

Pseudodiademas from the Great Oolite.

- 3 *a.* PSEUDODIADEMA PENTAGONUM, *McCoy*, p. 115. Upper surface of the test, natural size.
 - b.* Lateral view of the same, natural size.
 - c.* A portion of an ambulacral area, with the poriferous zones, showing the bigeminal arrangement of the pores, magnified four times.
 - d.* One inter-ambulacral plate, and a portion of an ambulacral area with the poriferous zones; magnified four times.
4. PSEUDODIADEMA PARKINSONI, *Desor*, p. 114. Test and spines, copied from Parkinson's 'Organic Remains.'

Pseudodiademas from the Cornbrash.

- 5 *a.* PSEUDODIADEMA HOMOSTIGMA, *Agassiz*, p. 118. Test, the natural size.
- b.* Upper surface of the same, magnified two diameters.
- c.* The base and mouth opening, magnified two diameters.
- d.* Lateral view of the same, magnified two diameters.
- e.* Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones; magnified five times.
- f.* An inter-ambulacral plate and tubercle, magnified five times.

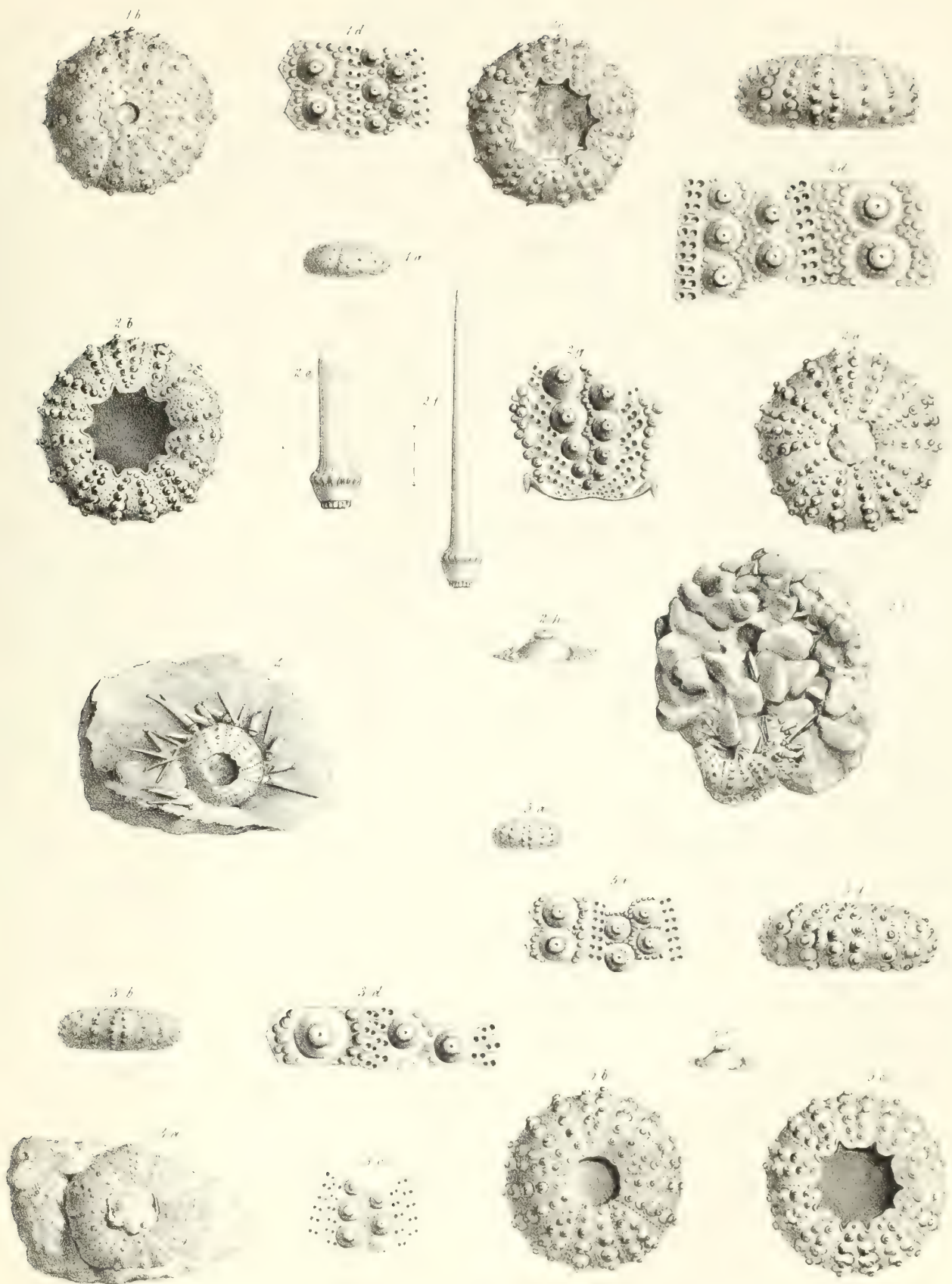


PLATE VII.

Pseudodiademas from the Cornbrash.

Fig.

- 1 *a.* PSEUDODIADEMA BAILYI, *Wright*, p. 120. Upper surface of the test, natural size.
b. Under surface and mouth opening of the same, natural size.
c. Lateral view of the same, natural size.
d. Half of the base, showing the peristome, &c., magnified three diameters.
e. Half of the upper surface, magnified three diameters.
f. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified six diameters.
g. A plate and tubercle, seen in profile, magnified six diameters.
- 2 *a.* PSEUDODIADEMA BAKERIE, *Woodward*, p. 121. Upper surface of the test, natural size.
b. Lateral view of the same, natural size.
c. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified four diameters.

Pseudodiademas from the Coralline Oolite.

- 3 *a.* PSEUDODIADEMA RADIATA, *Wright*, p. 131. Upper surface of the test, natural size.
b. Under surface of the test, natural size.
c. Lateral view of the test, natural size.
d. The half of the upper surface, magnified three diameters.
e. The half of the under surface, magnified three diameters.
f. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified six diameters.
g. An inter-ambulacral plate and tubercle, seen in profile, magnified six times.
- 4 *a.* PSEUDODIADEMA VERSIPORA, *Phillips*, p. 124. Upper surface of the test, natural size.
b. Base and mouth opening of the same, natural size.
c. Lateral view of the same, natural size.
d. Half of the upper surface, magnified two diameters.
e. Half of the under surface, magnified two diameters.
f. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified four diameters.
g. An inter-ambulacral plate and tubercle, seen in profile, and magnified four times.

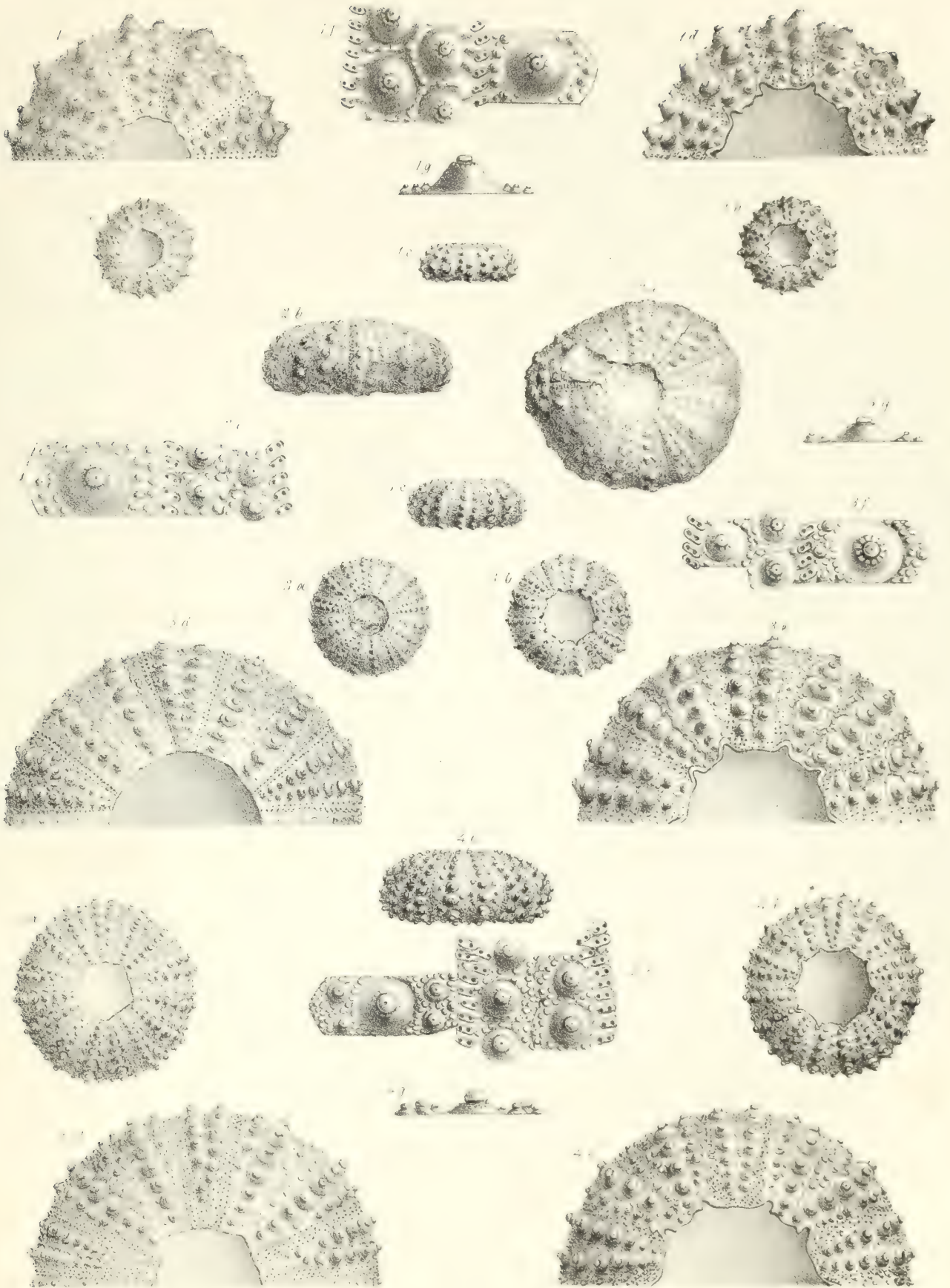


PLATE VIII.

Pseudodiademas from the Coralline Oolite.

Fig.

- 1 *a.* PSEUDODIADEMA HEMISPHERICUM, *Agassiz*, p. 127. Upper surface of the test, natural size.
b. The half of the under surface of the same, natural size.
c. A lateral view of the same, the natural size.
d. The half of a portion of an inter-ambulacral area, and a portion of an ambulacral area, with the poriferous zones; magnified twice.
e. Apical disc, magnified two diameters.
f. Base of an ambulacral area, showing the trigeminal pores in this region.
- 2 *a.* PSEUDODIADEMA MAMILLANUM, *Roemer*, p. 132. Upper surface of the test, natural size.
b. Under surface of the test, natural size.
c. Lateral view of the test, natural size.
d. The half of a portion of an inter-ambulacral area, and a portion of the ambulacral area, with the poriferous zones; magnified three diameters.
- 3 *a.* CIDARIS BOUCHARDII, *Wright*, p. 36. Lateral view of a very fine test of this species, from the Inferior Oolite.
b. One inter-ambulacral plate, and a portion of an ambulacral area of *Cidaris Bouchardii*, with a small secondary spine found on the test, magnified four times.
- 4 *a.* CIDARIS FLORIGEMMA, *Phillips*, p. 44. Under surface of a young test, natural size.
b. Upper surface of the same, natural size.
c. Lateral view of the same, natural size.
d. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones, magnified three diameters.
e. Inter-ambulacral plate and tubercle, seen in profile, and magnified three times.
5. DIPLOCIDARIS DESORI, *Wright*, p. 56. Inter-ambulacral plate, ambulacral area, and poriferous zones; natural size; the only fragment I know.
- 6 *a.* HEMICIDARIS RAMSAYII, *Wright*, p. 83. Lateral view of the test, natural size.
b. Upper surface, magnified three diameters.
c. Under surface, magnified three diameters.
d. Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones; magnified five times.
e. The apical disc, magnified once and a half.

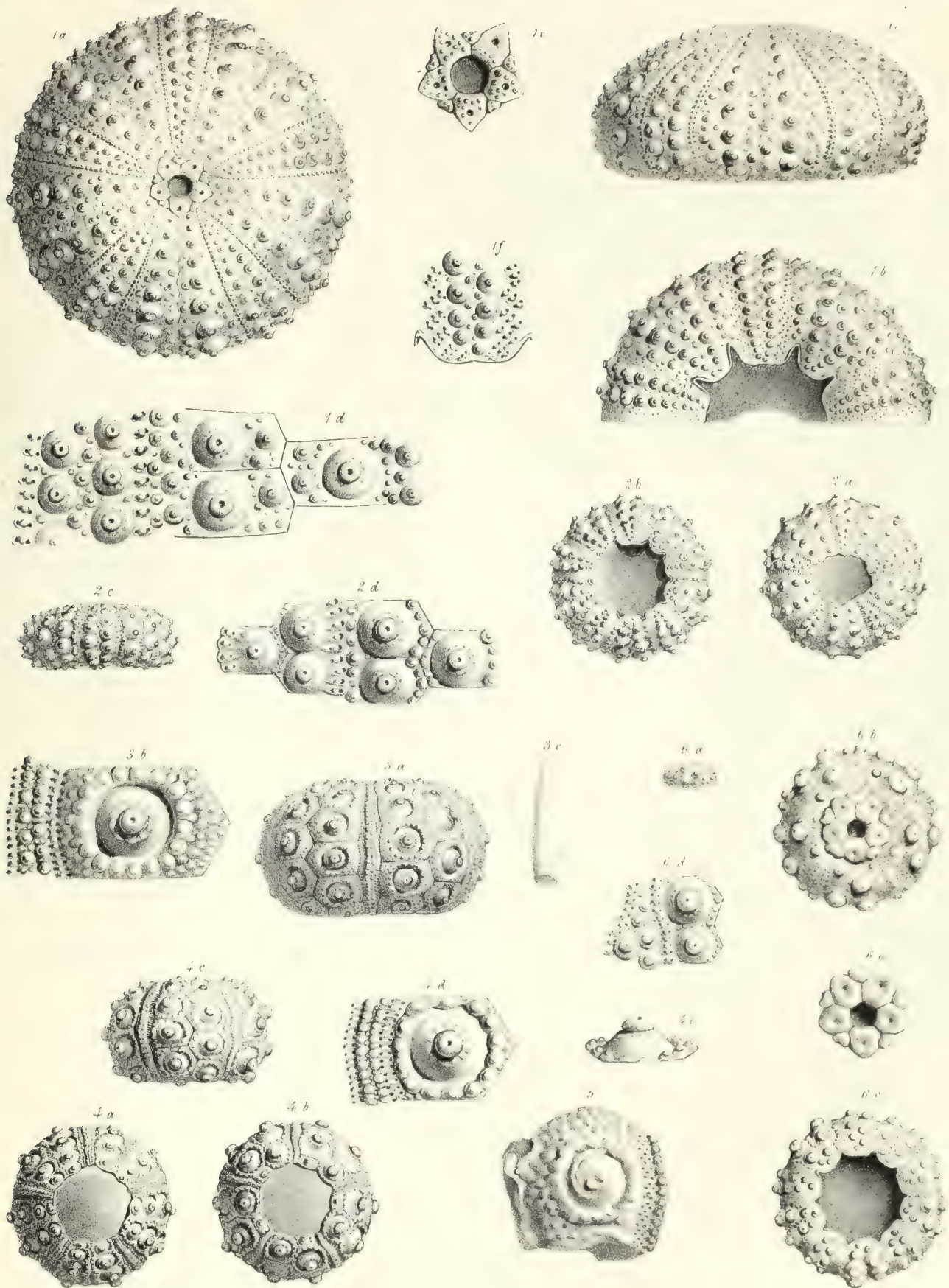


PLATE IX.

Hemipedinas from the Lias.

Fig.

- 1 *a.* HEMIPEDINA BECHEI, *Brodrip*, p. 144. Test with spines *in situ*, natural size.
b. A primary spine, magnified three times.
- 2 *a.* HEMIPEDINA BOWERBANKII, *Wright*, p. 145. Test with spines, natural size.
b. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones; magnified five diameters.
c. A primary spine, magnified three times.
- 3 *a.* HEMIPEDINA (DIADEMA) SERIALE, *Leymerie*, p. 146. From the Lias of France copied from the 'Mem. de la Société Géologique de France,' t. ii, pl. 24, fig. 1.
To show the form and structure of the test of a very rare allied species.
b. One of the inter-ambulacral plates and poriferous zones, magnified.
- 4 *a.* HEMIPEDINA JARDINII, *Wright*, p. 146. Upper surface of the test, natural size.
b. Under surface of the test, natural size.
c. Lateral view of the test, natural size.
d. Upper surface of the test, magnified three diameters.
e. Under surface of the test, magnified three diameters.
f. Lateral view of the test, magnified three diameters.
g. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones, magnified nine times.
- 5 *a.* HEMIPEDINA ETHERIDGII, *Wright*, p. 148. Upper surface of the test, natural size.
b. Under surface of the test, natural size.
c. Lateral view of the test, natural size.
d. Upper surface of the test, magnified three diameters.
e. Under surface of the test, magnified three diameters.
f. Lateral view of the test, magnified three diameters.
g. One inter-ambulacral plate, and a portion of an ambulacral area, with the poriferous zones, magnified nine times.

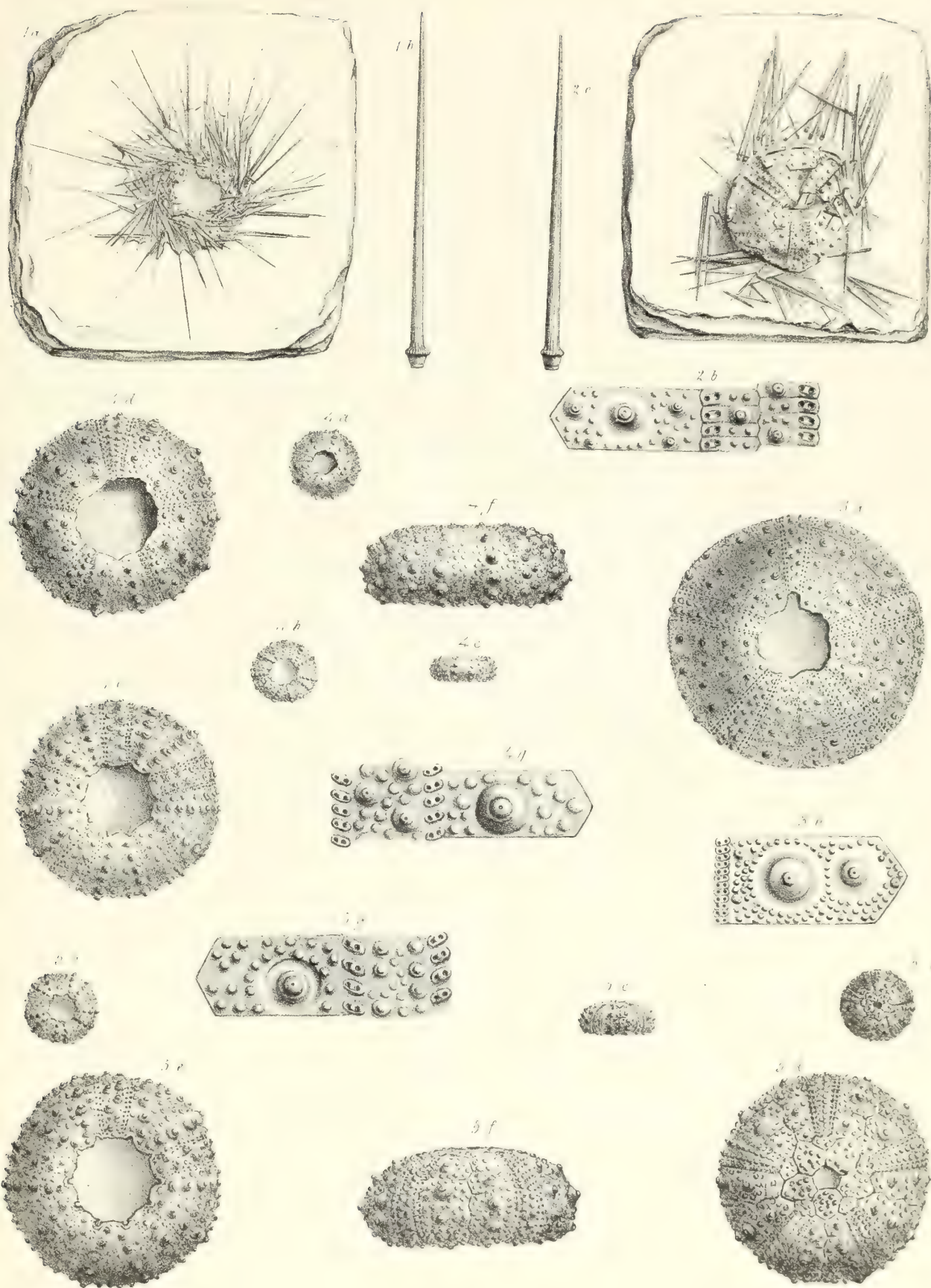
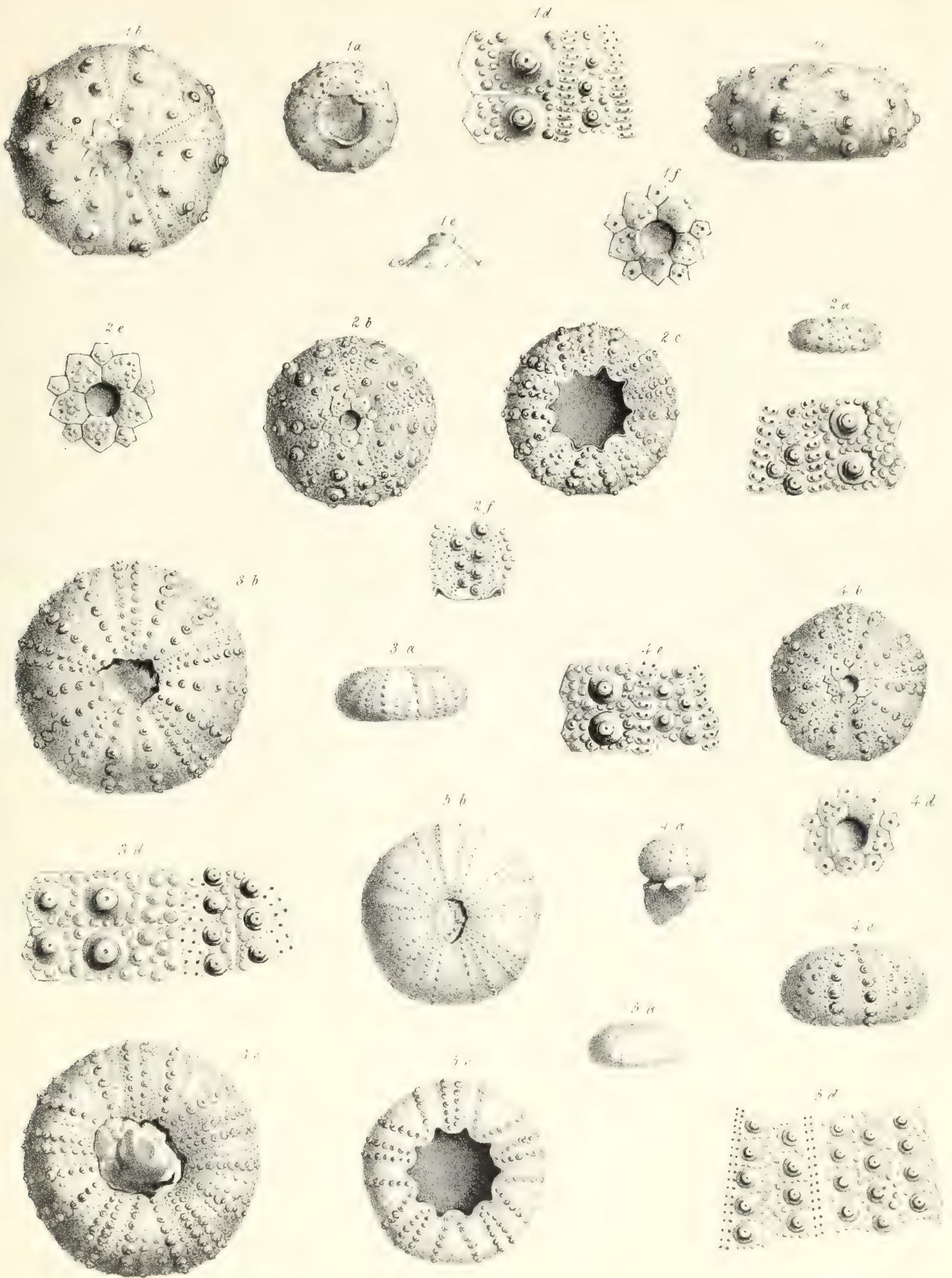


PLATE X.

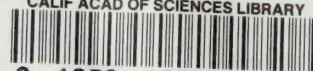
Hemipedinas from the Inferior Oolite.

Fig.

- 1 *a.* HEMIPEDINA BAKERI, *Wright*, p. 149. Under surface of the test, natural size.
b. Upper surface of the test, magnified two diameters.
c. Lateral view of the test, magnified two diameters.
d. Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous rows ; magnified two diameters.
e. Inter-ambulacral plate and tubercle, seen in profile, and magnified three times.
f. The apical disc, magnified three diameters.
- 2 *a.* HEMIPEDINA PERFORATA, *Wright*, p. 151. Lateral view of a test, natural size.
b. Upper surface, magnified two diameters.
c. Under surface, magnified two diameters.
d. Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous rows ; magnified six times.
e. Apical disc, magnified two diameters.
f. Base of an ambulacral area, showing the trigeminal arrangement of the poriferous zones in this region.
- 3 *a.* HEMIPEDINA TETRAGRAMMA, *Wright*, p. 152. Lateral view of the test, natural size.
b. The upper surface, magnified two diameters.
c. Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones ; magnified five diameters.
- 4 *a.* HEMIPEDINA WATERHOUSEI, *Wright*, p. 154. Lateral view of the test, natural size.
b. Upper surface, magnified two diameters.
c. Lateral view, magnified two diameters.
d. Apical disc, magnified four diameters.
e. Two inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones ; magnified three diameters.
- 5 *a.* HEMIPEDINA BONEI, *Wright*, p. 156. Lateral view of the test, natural size.
b. Upper surface of the test, magnified two diameters.
c. Under surface of the test, magnified two diameters.
d. Three inter-ambulacral plates, and a portion of an ambulacral area, with the poriferous zones ; magnified six diameters.



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